CONCRETE FOR RAILROAD WORK.

American Portland cement has been marketed as a commercial product only about 15 years, yet in that time the production has increased from 355,000 barrels in 1890 to more than 17 million barrels in 1902. The production of natural cement in 1902 was eight million barrels, and a trifle less than two million barrels of Portland cement were imported from Europe, so that the total consumption for that year was 27 million barrels. Most of this was used for concrete masonry, although prior to 1895 the use of concrete for exposed structures other than hydraulic work was almost unknown. Exhaustive tests have demonstrated that the American product is equal in every respect to the imported Portland cements which have been in use long enough to prove their durability; and with the increased production, the cost has been reduced to a point where concrete can be put in place under almost any conditions at a less cost than an equal quality of stone or brick masonry.

For railroad structures concrete has many advantages over brick or stone besides cost; and it is coming into very general use for such structures. Elsewhere in this issue are descriptions of two important and interesting applications of concrete masonry to structures under railroad track, one showing plans for a number of standard arch-culverts, abutments, cattle-passes and solid bridge floors for a new road, and the other giving detail costs of work in which concrete was used to replace timber trestles or brick and stone walls. On the St. Louis, Kansas City & Colorado, about 500 culverts and all the necessary bridge piers, abutments and road crossing arches were made of concrete; and in all 75,000 cubic yards were used in the construction of 300 miles of new road. No brick or stone arches or walls were put in. The Nashville, Chattanooga & St. Louis is now using concrete, laid with the company's own force of unskilled laborers, for all of its masonry work, including foundations, retaining walls and culverts, replacing wooden trestles. These are but two of many examples of the extensive and varied applications of this comparatively new material.

Some roads, notably the Pennsylvania and the New Haven, still hold to standard third-class broken range stone masonry for arched bridges and piers, heavy retaining walls and similar work, because they believe that better structures can be built in that way at little greater cost than for concrete. This is doubtless true if a good quality of stone is available at some point on the company's lines not far from the site of the work, and if the magnitude of the work is such that a force of masons and stone cutters of sufficient size to be handled to advantage can be used. In Newark, N. J., the Lackawanna has recently completed its track elevation and depression, covering a distance of 3½ miles, at a cost of $3,000,000, and concrete has been used exclusively for all retaining walls and bridge abutments. This work was begun simultaneously with the Pennsylvania's track elevation in the same city, on which rock-range masonry was used throughout. No comparison can be made between the time of completion of the Lackawanna's work and the Pennsylvania's work, because of the different conditions encountered in the nature and amount of the excavation and filling work which was done. The Lackawanna change of grade was made under conditions which were probably more difficult than those encountered by the Pennsylvania. But the two undertakings were finished at about the same time, and the concrete work probably cost much less than stone masonry would have cost under the same conditions. One piece of work is apparently as substantial and durable as the other, and the question of using stone or concrete for similar work in other places can be decided entirely upon the estimates of relative costs.

The detailed statement of cost for concrete culverts and other small structures, as given by Mr. H. M. Jones, shows that in some cases unskilled negro labor at 90 cents a day was employed under the direction of a competent foreman, and these men, after some little experience, were able to do the work quite as well as higher priced men could do it. The only high-priced men employed were the carpenters who built the forms. When not engaged on that work they were used in the mixing and placing gangs. To build stone culverts of similar size would require practically the same amount of timbering for the arched centers, the installation of a derrick and hoisting engine, and the employment of masons and other high-priced labor for doing nearly all of the work. There would be besides this the possible delay to trains on a busy road by holding the work train at the site to unload material. In case it was necessary to build a storage spur for holding cars loaded with material, the cost of such a spur would have to be charged against the work. In many places, as for example, under an existing wooden trestle, it would be extremely difficult to place the stones in the arched ring, because of the interference of the bents and bracing with the free movement of the derrick. Where concrete is used the material can be dumped from wheelbarrows or shoveled into the forms directly from the mixing boards in very close quarters, and without difficulty.

Suitable building stone is not always at hand, but almost any kind of hard, homogeneous stone or clean gravel can be used as a body for concrete. Very often, also, stone taken from a newly opened quarry which appears to be sound and durable will disintegrate after some years' exposure, and fall to pieces little by little. Concrete made from a reliable brand of cement is of known quality and can be depended upon. Tests have shown that its strength increases with age, and in at least one case of a burned factory building with concrete walls and floors it was found that the strength of the concrete had materially increased after being exposed to heat that would have cracked and chipped stone or brick. Perhaps the greatest advantage of concrete is its adaptability for any complicated or unusual form. In every stone arch each ring-stone must be carefully laid out and cut to accurate dimensions in order that the stresses may be transmitted uniformly through the arch, and it is seldom that the plans for one stone structure can be used for another without changes. Concrete can be moulded into any shape, and, if properly placed and well spaded next to the forms, a smooth, clean surface can be obtained.

One point which does not yet seem to be satisfactorily established is the effect of freezing concrete before the final set has taken place. Some specifications require that no concrete shall be placed during freezing weather, and, on the other hand, some of the most extensive pieces of concrete work in this country have been carried out and completed during severe winter weather. Neat cement will take an initial set after about half an hour, but the final set does not take place until after from thirty to sixty days' exposure. The water which is added in the mixing brings about the first chemical combination of the particles which gives the cement its initial set. If this action is arrested by freezing, the mixture remains inert until thawed out, when the chemical action again begins. Numerous tests have been made to determine the effect of freezing and thawing, but unfortunately there is still a wide divergence of opinion. Mr. Campbell states that tests made during the progress of the work on the St. Louis, Kansas City & Colorado showed that freezing resulted in a loss of strength and that salt was worse than useless as an ingredient of the mixture to prevent it, since it takes place only at temperatures below which a salt solution will freeze. The only satisfactory method of placing concrete in winter weather, which appears to have been tried to any extent, is heating the ingredients, before mixing, in stoves and placing the concrete while still hot. If the mass is large enough and is covered by straw or some other frost-proof covering, enough heat is retained to prevent freezing until after the water in the mixture has combined with the cement as water of combination. After this there is little damage to the concrete by exposure to freezing temperatures, and work carried out in this manner during the coldest weather has not yet developed any serious defects. There is need of a reliable series of tests and experiments made under actual service conditions and in the laboratory, to determine the effect of freezing temperatures on large and small bodies of concrete.

The report that the American Railway Association will next week enthusiastically adopt a rule requiring all applicants for employment in the train and station service, or for promotion therein, to undergo and pass a thorough physical examination, ought to be (and we suppose is) true. There is no question of the desirability and importance of such examinations, and if any railroads are waiting for the Association to declare itself before they establish examinations, their excuse ought to be demolished without delay. The Chicago & North Western and other enterprising companies have examined applicants for nine years or more. That examinations should deal with all vital parts and important functions is indicated by the results of the North Western's examinations, which were published by Mr. R. C. Richards, general claim agent of the company. Out of

443 men rejected, 102 rejections were for "hernia, heart and lung troubles, loss of fingers, etc." A defective heart sometimes causes a train accident. Of 8,397 men examined, including some who were already in the service as firemen and brakemen and who desired promotion, 1,061 or 12.6 per cent. were rejected; and Mr. Richards believes that the knowledge that examinations would be required led as many more defectives to refrain from applying. They could go to roads not so strict. Railroad surgeons sometimes appear to be over-nice in their standards, as, for example, when they talk in conventions about sleeping-car sanitation; but in this matter of excluding defective men from the service there is no danger of setting the mark too high, and the surgeons' influence ought to be extended. An examination for color-blindness alone is a poor apology for a complete physical examination. There would be no harm in going even beyond the surgeons' requirements, and letting Dr. Scripture, or some other psychological expert, measure the men's quickness and accuracy of perception and the clearness and precision of their mental processes. Such an innovation would call forth a vigorous remonstrance no doubt—as did color-blind examinations a few years ago (and in some places even now)—and we are not advising any superintendent to pick a quarrel with a brotherhood; nevertheless the diplomatic superintendent who will put in practice some of the good advice that Dr. Scripture has given, will do the world a service.

Probably the liveliest discussion in the meeting will be that on per diem, a subject on which many members will have very definite views, and ready tongues to express them. As intimated in the foregoing paragraph, physical examinations ought to have no discussion at all, everybody ought to vote aye at once. But on the subject of per diem one feature alone, the amount of the price per day, could be discussed for a week. The notes on the subject by Mr. Hale, published in this paper last week and this, would seem to indicate that he does not think the rate ought to be changed at present; and as his committee report recommends nothing but changes in details it is fair to conclude that the majority of his fellow members agree with him. But the advocates of an increase of the rate from 20 cents a day to 30 cents or more have much logic and reason in their arguments, as well as a mass of facts with which to drive them home, and they can hardly be expected to keep still. It is right for the committee to be conservative at this stage—though it was so bold at the outset—but cars are constantly increasing in average value and capacity and an increase in the exchange rate is bound to come. It is not believable that it can be as long coming as was the change from mileage to per diem, and members who have facts which will support the propaganda have a duty to lay them before the Association; for many minds will have to be informed thoroughly on the subject before satisfactory progress can be made. The spread of knowledge as to the need of more equitable rates—different rates for different classes of cars, perhaps—will be a great aid in securing the adoption of per diem rates for private cars, which every enlightened operating officer desires to see accomplished; for if the rates offered on refrigerators, for example, were to be 50 cents a day some of the car owners might yield.

The discussion on refrigerator-car rates which took place at Chicago last week, and which was reported widely in the newspapers, while telling nothing new to operating officers may be useful in arousing some of these officers' superiors to the inequitable arrangements that are in effect. The remedy for the evil, however, is not easily found. The payment by railroads of exorbitant rates for the use of shippers' cars—or cars which are used as a means of giving shippers a benefit—is essentially a cutting of transportation rates, and is usually as vicious and as hard to detect and prevent as other kinds of rate cutting. While some car-owners make 50 per cent. annually on their capital others do not make nearly so much. The evidence that the cars of the Union Tank Line earn only 5 or 6 per cent. on their cost was one of the most significant incidents of the Chicago hearing. If the rates were to be reduced and the car line driven out of business, and the railroads were obliged to furnish tank cars themselves, apparently the only change effected would be that losses, when borne by the railroads, could be concealed. It is not likely that they could be abolished (unless railroads could get capital at a lower rate than the car company), for the Tank Line probably builds, maintains and distributes its cars with reasonable economy; and losses would simply fall on some other department of the railroad service.

The tank line incident sharply illustrates the point made by Mr. Hale, in his paper, that a single uniform rate cannot be made to fit different kinds of cars used in many different kinds of traffic. Mr. Midgley has done a useful service in making public some crying abuses; but to find and apply a remedy it will be necessary to go far. Commissioner Prouty seems to think that Congress is the place to go; but a journey to that fountain head of justice will be a long one in time if not in space, for the members of the Congressional Committee would probably ask for time to accomplish something on their present anti-trust puzzles, before being required to take up a new one. A Federal law requiring the railroads to themselves provide all kinds of cars would be so inequitable in many of its applications that it would be likely to prove unworkable. To draft a statute which would fairly regulate the use of cars not owned by the railroads would, very likely, prove impossible. The only alternative to Mr. Prouty's suggestion is to appeal to individual railroad managers to clean out their own Augean stables, each for himself. Any hope of a general success by working in this direction must depend on finding a large number of rather unusual men; men who manage their railroads with full regard for the interests of their stockholders and the rights of shippers but with careful disregard of big shippers' unreasonable or illegal demands; with intelligent knowledge of the workings of their freight-car department and of the logical superiority of the per diem principle over the mileage principle; and possessing the courage and persistency necessary to induce other and weak-kneed railroad officers to join in the battle for decent and rational business methods. Such a railroad officer must, of course, be actuated by a high public spirit and never think of his own pocket.

Erie.

The net income of the Erie Railroad for the year to June 30 was $4,552,053. This amounted to 9.5 per cent. on the first preferred stock, or to 7.1 per cent. on the first and second preferred together. If 4 per cent. had been paid on both preferred stocks there still would have remained nearly 2 per cent. for the common.

The year was a peculiarly severe one. The company suffered from disastrous floods in the early part of the year, and this was succeeded by a very rough winter. The upward movement of wages and prices continued and culminated during the year, while the freight traffic declined. The only favoring factors were the increase in the coal tonnage and in the average receipts per ton-mile on merchandise freight. Erie's mileage for many years has been practically unchanged, but there has been a steady increase of second track. This year 35 miles of such track were added. This mileage was pretty well distributed over the road to provide passing tracks where most needed. Ten iron bridges were replaced by heavier steel bridges. In general the bridges and roadbed have been kept in very fair condition. The bridges of the main line are now up to requirements of the heavy engines.

Some $44,000 was spent in grade reductions and relocations. Extensive improvement work by the roadway department has, apparently, been deferred again this year, and is waiting upon the final formulation of an adequate improvement policy that shall attack comprehensively the problems of grade, terminals and road facilities. The rail of the main line is now up to 90-lb. standard, and the renewals for the year have been fair.

Erie's equipment has for years been conspicuously inadequate. The past year is specially marked by the heavy additions of new power, with 2,200 freight cars and 62 passenger train cars. One hundred and fifty new locomotives have been added. This reduces the average age of locomotives 11 months, bringing it down to a little under 13 years. The new freight cars are very few compared with the real need. Since the close of the fiscal year the company has bought 3,500 more. These displace 5,261 of an average age of 23 years. With these changes, Erie now has about 51,000 freight cars of all kinds, of which about 40 per cent. are nine years old or less.

The financing of the year was principally concerned with the purchase of this new equipment. The entire expenditure upon the property was $9,028,602. Of this amount about $6,000,000 went for equipment charged to capital account; and $800,000 was spent for land, yard improvements, coal storage plants, signals and interlocking, elimination of grade crossings, and additional tracks and sidings; this also was capitalized. The remainder, or $2,250,000, was spent for additional tracks and sidings, yards, stations and buildings, docks and piers, bridges and culverts, and various other roadway improvements, and was paid for out of earnings. The financing is told by the table below:

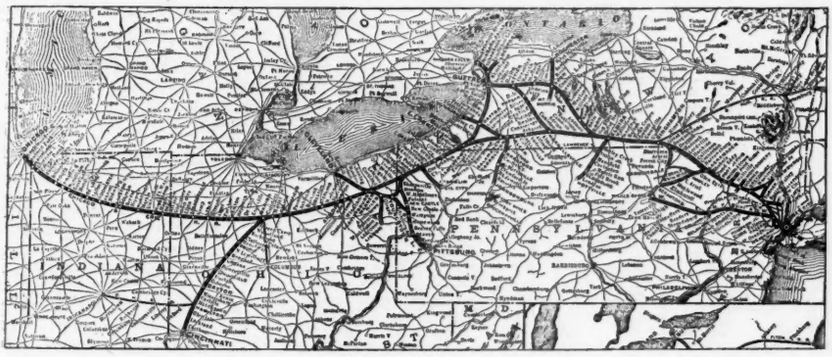
Debit.	
Liabilities increased—	
Funded debt	$3,860,000
Interest and rents accrued	15,037
Pa. Coal Co., sinking fund	313,606
Current liabilities: Profit and loss	1,398,209
Assets decreased—	
Miscellaneous securities	270,221
Current assets (net)	4,940,825
	$10,797,898

Credit.	
Assets increased—	
Road and equipment	$7,263,521
Materials and supplies	1,186,165
Trust and sinking fund	301,232
Due from subsidiary companies	517,896
Advance payments	35,646
Liabilities decreased—	
Construction obligations	25,916
Mortgages	4,000
Equipment trusts	522,915
Reserve funds	940,607
	$10,797,898

The earnings were as follows:

	1904.	1903.	Inc. or Dec.
Earnings	$45,201,163	$45,830,413	$629,250 D.
Expenses	32,581,838	29,925,758	2,656,079 I.
Net	$12,619,325	$15,904,654	$3,285,329 D.
Other income.	789,312	1,430,230	640,918 D.
All income	$13,408,637	$17,334,885	$3,926,248 D.
Charges	8,856,584	8,901,618	45,034 D.
Net inc..	$4,552,053	$8,433,267	$3,881,214 D.

The striking thing in the income account is the heavy increase in expense with the decrease in earnings. This disparity is yet greater when we examine expenses in greater detail. Of the entire increase in expenses, $2,656,079, maintenance was accountable for but a little over $1,100,000, while transportation and general expense is chargeable with the remainder, or about 60 per cent. of the whole. The ton-mileage of



Erie.

all freight fell off 4 per cent., while the expense of handling it increased 9.2 per cent. This puts Erie this year into the class of roads which have not been able to hold their transportation expenses in hand. A large and unstated part of this was due to floods and the severe winter, but the detail of expenses would indicate that higher wages and higher prices for materials played a large part. One item stands out most conspicuously, namely, the increase in the coal bill. This amounts to $610,000, or nearly 20 per cent. The expense of fuel per locomotive mile as a result has this year reached 11.75 cents. The entire expense per locomotive mile is 32.55 cents, which must be regarded as excessive.

The operating averages were:

	1904.	1903.	Change.
Tons of freight*	29,835	31,645	1,810 D.
Ton-miles.*	5,189,158	5,407,350	218,192 D.
Average haul	173.93	170.87	3.06 I.
Receipts, ton-mile, cts	.627	.612	.015 I.
Frt. earn'gs per mile	$15,125	$15,362	$237.0 D.
Frt. train mile earngs	$2.51	$2.48	$0.03 I.
Fr. ct. loaded car-miles	68.7	68.3	.4 I.
Tons per train	400.12	406.26	6.08 D.
Tons, per loaded car.	17.44	17.88	.44 D.
Passengers carried*	20,395	19,976	419.0 I.
Passenger miles*	549,757	528,997	20,760 I.
Pass. train mile rev.	$1.108	$1,110	....

*(Thousands.)

The increase in ton-mile revenue amounts to 2½ per cent., and materially assisted in holding down the net decline in gross earnings. The balance of traffic was fair and changed little from the previous year. The tons per train fell and the tons per loaded car, but the better revenue more than offset these declines and produced a freight train mile revenue three cents greater than last year. Altogether this year will be conspicuous for the heavy expenses, the halting tendency of business, the purchase of new power, and the dissolution of the voting trust which has had the financial management of the property since its receivership.

Canadian Pacific.

In connection with the report of this company for the fiscal year, an announcement has recently been made that the stockholders have authorized an issue of $25,500,000 capital stock, to be used from time to time for improvement purposes. This raises the total capital stock from $84,500,000 to $110,000,000. In 1902, there was an increase of $19,500,000, making a total increase in two years of $45,000,000. But these figures, vast as they are, simply measure the tremendous growth of the system. During the last few years, the mileage has steadily increased, and large amounts have had to be spent on equipment and roadbed in order to meet the growing requirements of traffic. How fast this traffic has developed is shown by the large increases in gross receipts during the past eight years. For the present fiscal year, gross receipts were $46,469,132, an increase of $2,511,759 over 1903, while only as far back as 1896, the total gross earnings amounted to but $20,681,597—an increase of 130 per cent. in eight years. Freight receipts this year were $29,235,821, as against $28,502,082 in 1903 and $13,187,560 in 1896. Passenger receipts this year increased $1,416,445 over last, and $7,598,276 over 1896. The company has also added largely to its ocean, lake and river steamship service, and part of the $15,516,745 4-per cent. consolidated denbenture stock issued during the year was used for the purchase of 15 new Atlantic steamships. The continued expansion of revenues in the last few years is particularly satisfactory from the fact that it does not come from grain traffic alone, as in former years. The company has built up a varied traffic in lumber and in manufacturing, mining and farming articles. Notwithstanding a loss in the amount of grain hauled during the past year, the gains in other kinds of freight have enabled the company to show a fair increase in freight earnings.

The expansion of traffic having been large the expenses have necessarily been heavy, and the severity of last winter, almost unprecedented, caused an extra drain. For the year, operating expenses were $32,256,027, an increase over 1903 of $4,135,500. This left a decrease in net earnings of $1,623,741; and with a dividend on the common stock of 6 per cent. (instead of 5 per cent. as formerly) the surplus for the year comes down to $1,666,204.

The report contains an interesting table showing that total expenditures for improvements and additions to rolling stock and equipment since 1901 have amounted to $31,017,355. Of this sum, $19,500,000 was supplied by the stock increase made in 1902, $979,373 was obtained from the proceeds of the sale of preferred stock, $3,000,000 was especially set aside for that purpose from surplus earnings and $7,537,962 was temporarily advanced from earnings.

The average mileage worked during the year was 8,332, an increase of 594 miles. This includes those parts of the Pheasant Hills and Souris branches, which, although practically completed in 1903, were not included in the traffic returns of last year. The report states that 338 miles are now under construction, including an extension from Esterhazy in a northwesterly direction and the Arcola-Regina line. The more important statistics of operation follow:

	1904.	1903.
Average mileage worked	8,332	7,748
Gross earnings	$46,469,132	$43,957,373
Passenger earnings	12,418,419	11,001,974
Freight earnings	29,235,821	28,502,082
Mail and express	1,743,604	1,567,003
Steamships and misc.	2,350,282	2,248,672
Parlor and sleeping cars	721,006	637,642
Operating expenses	32,256,027	28,120,527
Maintenance of way	7,372,408	6,642,165
Maintenance of equip.	5,873,163	4,864,551
Conducting transportat'n	16,149,578	14,045,460
Other expenses	2,860,878	2,568,348
Net earnings	14,213,105	15,836,846
Net income	8,318,277	10,071,461
Surplus	1,666,204	3,983,960

St. Louis Southwestern.

One of the interesting features of this company's report is the steady increase in the average train load which it has now shown for several years. Although the train load this year is not so very much larger than it was in 1903, it still shows a fair percentage of increase. The following table gives the average train loads of the St. Louis Southwestern proper, the St. Louis Southwestern of Texas and the entire system for the past five years.

	St. L. S-W. Ry.	St. L. S-W. Ry. of Texas.	Entire system.
1900	292	149	231
1901	318	151	236
1902	344	160	256
1903	384	167	282
1904	388	172	285

Gross receipts for the year were $7,649,485, an increase of $370,910 ($191,606 in freight, $137,753 in passenger). The ton mileage for the year was 508,377,628 tons, an increase of 6,158,163 tons. The average class of freight carried was of a higher quality, consisting of lumber, agricultural products and general merchandise, which increased the average ton-mile revenue from .110 cents to .113 cents. There was a gain of 10 per cent. in passenger receipts.

Although maintenance of way charges decreased slightly, increases in the maintenance of equipment and conducting transportation accounts resulted in an increase in the total operating expenses of $165,434. Expenditures for betterments and additions to existing lines were $718,157. This amount, together with a portion of the expenditures made during the preceding year for the same purpose amounting to $375,984, were originally charged to a temporary current account; but the company has issued first consolidated mortgage bonds and the total amount of these expenditures, aggregating $1,094,141, has now been entered under cost of road.

Net earnings were $2,227,888, an increase of $205,499. After subtracting all fixed charges for the year, there was a decrease in surplus of $26,007 over 1903. This was due to an increase in interest charges resulting from the issuing of $120,000 of first consolidated mortgage bonds, and to the sum of $25,000 charged to income account for equipment payments. The chief statistics of operation follow:

	1904.	1903.
Average mileage worked	1,303	1,291
Gross earnings	$7,649,485	$7,278,575
Operating expenses	5,421,597	5,256,164
Net earnings	2,227,888	2,022,411
Surplus	668,828	694,835

Northern Pacific.

The Northern Pacific earned, net, in the fiscal year closing June 30, 1904, $15,229,310, or 9.82 per cent. on the $155,000,000 of stock. Last year it earned $14,745,889, or 9.51 per cent. The policy of building small feeders still continues, and in the past year 202 miles were added to the operated mileage of the road. Fifty-seven miles of this consisted of two extensions, one of 45 miles in North Dakota, and one of 12 in Washington. The lines bought were the Monte Cristo Railway, 42 miles; Washington Railway and Navigation lines, 56 miles; Bellingham Bay & Eastern, 23 miles; Seattle & San Francisco, 3 miles. In addition to these 106 miles, composed of 6 small extensions, are in process of construction, but not finished.

Grade revisions of the year to be completed this fall reduce the maximum grade on the Idaho division to .4 per cent. westbound and .5 per cent. eastbound. During the year 285 bridges were replaced and one eliminated, the whole length thereby changed amounting to 5.3 miles. There was little change in the equipment. The 16 added locomotives came with the purchase of the branch lines. Only about 200 freight cars were added, and there was practically no change in passenger train equipment.

About $4,630,000 was spent upon the property and its equipment and charged to capital account. About $1,000,000 of this was raised by increasing the funded debt. Other changes in the balance sheet were not of significance. They resulted in an accumulation of about $7,000,000 more of cash, which was drawn from various funds and by deferring certain payments. The reserve funds, however, have increased over $1,000,000.

The income account for the year was:

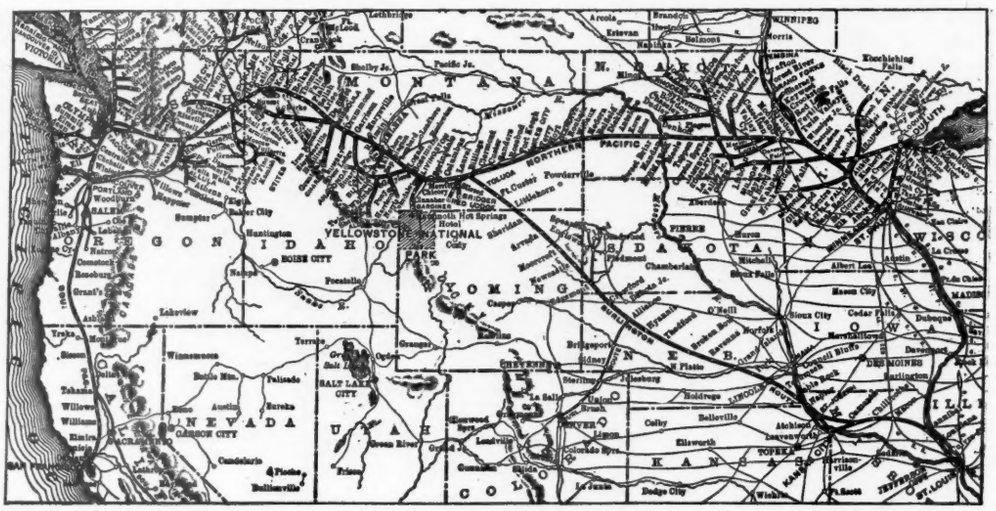
	1904.	1903.	Increase.
Earnings	$46,524,574	$46,142,104	$382,470
Expenses	24,234,542	24,032,092	202,450
Net	$22,290,031	$22,110,011	$180,020
Less taxes	1,421,433	1,421,433	41,341
Balance	$20,827,256	$20,688,578	$138,677
Other income	1,483,354	1,112,550	370,803
All income	$22,310,610	$21,801,129	$509,481
Charges	7,081,299	7,055,239	26,060
Surplus	$15,229,311	$14,745,890	$483,421

The income account, for the first time in seven years, is practically stationary, showing an increase of only about 1 per cent. in gross earnings. Northern Pacific has had a tremendous expansion of gross earning power, due to the development of the territory which it serves; and the income figures of the year show certain of the tendencies which we should expect to find in time. The ton mile revenue has declined nearly 3 per cent., and the ton miles hauled have increased nearly 2 per cent. The actual freight earnings show a decrease of a little less than 1 per cent.

Another tendency which we should expect to find is the development of passenger business. This year passenger earnings increased $484,000, which more than made good the loss on freight earnings, so that out of both passenger and freight the road was able to produce a net gain of $382,000. The tonnage moving was fairly well balanced by direction. It is an interesting fact that the balance, such as it was, shifted so that the preponderance of movement was westbound instead of eastbound. The principal factor in this change was the decline in wheat, flour, other mill products and forest products eastbound, and the increased shipment of forest products westbound.

The expenses were about $202,000 greater than last year, and the increase in the two items of maintenance of equipment and conducting transportation (about $561,000) was much greater than the net increase of all the items (including general expenses) for there was a decrease in maintenance of about $471,000. The increase in transportation expense is not unreasonable, in view of the fact that there has been an increase in ton mileage of 2 per cent. and a very considerable increase in passenger earnings, while this has been a year of advances in wages. In transportation expenses the fuel bill, as is the case on most roads, is the principal item of increase. And this difference seems to be very largely a difference of price and not of quantity consumed.

There does not appear to be in the report of the year past anything of especial moment except the fact which stands out above all others that the traffic has not increased with its former rate of expansion. Two per cent. increase in freight ton mileage is less than we should expect to find in a fairly normal year on Northern Pacific. In the previous year the increase was nearly 16 per cent.



Northern Pacific.

NEW PUBLICATIONS.

American Railway Shop Systems. By Walter G. Berg, Chief Engineer, Lehigh Valley Railroad. New York: Published by the *Railroad Gazette.* 6 in. x 9 in. Cloth, 198 pages. Price $2.

The subject of this work is one with which Mr. Berg is peculiarly well adapted to deal. It necessitates the gathering of a great mass of drawings, photographs and descriptive matter, and it has to be arranged philosophically, because the reader usually finds it necessary, or at any rate desirable, to examine the data on which are based the author's conclusions. No summarizing in words takes the place of drawings. Mr. Berg has collated with his usual care and industry and has made simple and rational classifications. He has brought together ground plans of over 40 prominent railroad shops for repairing locomotives, or cars, or both; and including some large shops of establishments not owned by railroad companies; and he has grouped his material for easy comparison, study and reference. He has recent examples in abundance, but has neglected no meritorious plan because it was not new. Besides the line drawings there are numerous full-page half-tone photographic engravings. There is a bibliography filling seven pages and containing references to apparently all of the good articles on this subject which have appeared in the railroad journals within the past dozen years.

Reinforced Concrete. By A. W. Buel and C. S. Hill. New York: Engineering News Publishing Company. 1904. Cloth, 434 pages.

Reinforced or armored concrete is of such recent origin and development that as yet the theory of its design is unsettled and lacking in agreement between the results of the investigations by the many engineers who have attempted to work out a rational theory which conforms to the results in practice. A great mass of literature has been written on the subject, much of which is contradictory and misleading, but notwithstanding, reinforced concrete has made rapid strides in advance and is being used more and more every day. For some purposes it is the ideal material, and many engineers would be glad to have, in some concise form, practical working formulas for the design of reinforced concrete structures. The authors of this book have endeavored to supply this want. As far as possible theoretical discussions have been omitted and practical working formulas, with records of actual practice in the selection of materials and of methods of workmanship and construction, have been supplied instead. For convenience the book has been divided into three parts. Part 1, which has been written by A. W. Buel, considers the formulas necessary for the calculation of stresses and the design of all classes of reinforced concrete structures, together with many facts about the properties of concrete and steel which are necessary in developing economical engineering designs. Part 2 is devoted to descriptions of a number of representative structures of reinforced concrete. Part 3 takes up materials, workmanship and methods of construction, and is illustrated by examples from actual practice. Much space is devoted to the construction of centers and forms for concrete work and to methods of facing and finishing exposed surfaces. The illustrations in the book are uniformly good and supplement the very complete descriptions.

New York Air-Brake Catechism. By Robert H. Blackall. New York: Norman W. Henley Publishing Company. 1904. Cloth, 250 pages. Price $1.25.

Blackall's Catechism of the Air-Brake is a standard book among railroad men and the information which it contains about the Westinghouse air-brake apparatus has been practically duplicated in this latest book, which describes the apparatus of the New York Air-Brake Company in the form of a catechism. Nearly a thousand examination questions on the New York air-brake apparatus, together with complete answers, are given, and many illustrations of the apparatus are shown to make clear the text.

Centrifugal Pumps. By Charles H. Innes, M. A. Manchester: The Technical Publishing Company, Ltd. D. Van Nostrand Company, New York. 1904. Cloth, 340 pages. Price 4s. 6d.

The theory of turbines, centrifugal pumps and fans has been completely covered in this book, which is a fourth and enlarged edition. All of the necessary data and formulæ for designing water and steam turbines and centrifugal pumps has been worked out in great detail. The book is illustrated with numerous diagrams and illustrations of machines built for commercial purposes.

TRADE CATALOGUES.

The Ingersoll-Sergeant Drill Co., New York, sends a copy of a pamphlet bearing the title "The Storage Air-Brake System at the St. Louis Transit Company." This pamphlet contains a short sketch of the storage air-brake system adopted by the St. Louis Transit Company. Reference is made to the tests of the system recently made by the Railway Test Commission at the Louisiana Purchase Exposition. Illustrations help to explain its operation. The pamphlet is issued jointly by the Ingersoll-Sergeant Drill Company and the Westinghouse Traction Brake Company, and is of special interest to street railway men.

The Buda Foundry & Manufacturing Co., Harvey, Ill., devotes its September Bulletin to switch stands. It is a complete catalogue of these devices and contains 31 pages. Seven general classes of stands are shown, including Ramapo automatic safety stands, semaphore stands, open-base stands, column stands, stands with tripod, yard-throw stands and ground-throw stands; also different kinds of connecting rods. The illustrations are all half-tone work from wash drawings and are clear and well executed. This bulletin is the seventh of these interesting publications.

The Yellow Strand is a publication of the Broderick & Bascom Rope Company, St. Louis, the October number being the first. On the first page is "Ropeology," a series of short, bright paragraphs about "Yellow Strand" and other things. On the inside are brief articles on "Rope Drive vs. Motor Drive," "Conscience in Rope Making," and a description of the B. & B. exhibit at the World's Fair. There are also a number of anecdotes in which the point always appears to be nicely applicable to "Yellow Strand," the company's trade-mark for its wire rope.

Arthur Koppel, New York, maker of industrial and standard gage railroad materials, is distributing a booklet bearing the title "On the Track." It opens with a reprint of an article from *Cassier's Magazine*, written by Ernst Wierner, manager of Arthur Koppel. The object of this article is to put parties who are looking for an economical method of handling materials "on the right track." Illustrations of equipment for industrial railways, such as steel rails, light turntables, wheels and axles, special cars, etc., are also given.

The Crane Company, Chicago, is distributing its special catalogue No. 100. It is 7 in. x 10½ in. and contains about 100 pages. Illustrations, descriptions and sizes of the different styles of valves made by this company are given as well as a number of illustrations of boiler fittings such as gages, chimes, steam-whistles, safety-valves, wrought iron and steel pipe bends, flanges, etc.

The Holland Company, Chicago, sends a circular about the Racine rail anchor, a device to prevent creeping of rails. It consists of two malleable-iron jaws which engage the rail flange on each side and are drawn together with a bolt. They bear against the tie, and if desired, anchors on opposite rails can be joined by one long bolt through the two to prevent spreading of the rails.

The Spaulding Print Paper Company, Inc., Boston, Mass., sends a pamphlet descriptive of its Federal blue-printing machine. This is a continuous printing apparatus for making blue prints by electric light. A detailed description as well as illustrations showing the general construction and method of using the machine are given.

The Northern Electrical Manufacturing Company, Madison, Wis., is distributing its bulletin No. 37. It is descriptive of the northern variable speed motor. A number of illustrations are given which show the application of this motor to the different types of machine tools.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., sends its bulletin No. 140. It contains a detailed description and illustrations of the form M oil switch. The switch is made in the two, three and four-pole style for both 2,500 and 6,600 volts.

The Becker-Brainard Milling Machine Company, Hyde Park, Mass., issues an illustrated pamphlet descriptive of its exhibit at the Louisiana Purchase Exposition.

Joseph Dixon Crucible Company, Jersey City, sends a pamphlet bearing the title, "The Lubrication of Axles." It describes "Dixon's everlasting axle grease," and also contains a number of testimonial letters from persons who have used it.

CONTRIBUTIONS

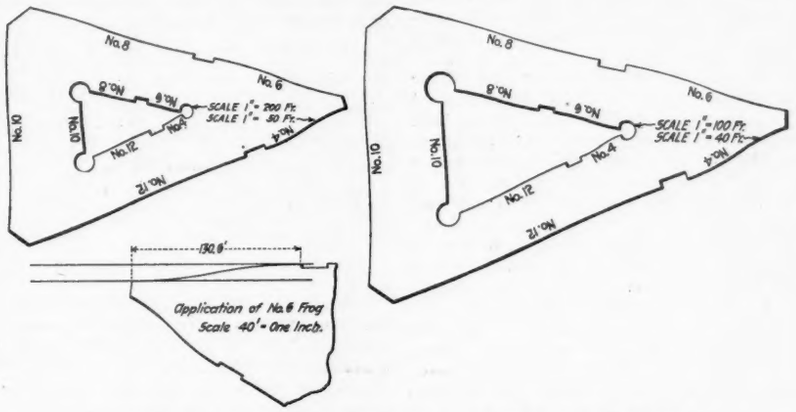
Curves for Cross-Overs.

Williamsport, Pa.

TO THE EDITOR OF THE RAILROAD GAZETTE:

The accompanying illustration shows a handy tool, a pair of which should hang in a convenient place in every drawing room where track work is done. The average civil engineer and maintenance of way draftsman can see at a glance the advantage to be gained by the use of such a tool, as the neat drawing of cross-overs is one of the most tedious tasks with which the draftsman has to contend.

The curves can also be used to determine almost instantly whether it is possible to get a cross-over in certain places as the length of the cross-over is given from one notch to the other.



Templets for Laying Out Curves for Cross-overs and Switches.

These templates can be made of pear wood, brass, rubber or xylonite (celluloid), the latter being the best, although the pair I have are brass and can be made to suit any scale. Mine are worked out on a basis of 12 ft. 2 in. track centers and to the scales of 40, 50, 100 and 200 ft. to the inch, which serves most purposes. The curves are also used for laying out shop yards.

A. P. SHARP.

Cost of Concrete Structures.*

BY H. M. JONES.

In attempting to get accurate costs of concrete work done by a railroad company's own forces, one is met at the outset with many difficulties.

1. Ignorance on the part of the foreman in charge of what is wanted as to cost records and his lack of experience as an accountant if he knows what is wanted. The separation of different classes of work where the same men are often called upon to execute both is a matter of judgment and is subject to wide variation.

2. Not many small jobs justify the time necessary to keep a record of cost of the various details of the work. Only foremen who have proved themselves efficient for the work are put in charge of gangs; and it is expected that they will prosecute all work under their supervision as rapidly and as

*Extracts from a paper presented to the Nashville Section of the Engineering Association of the South at the October meeting.

well as possible. To burden such men with the work of keeping the detail costs of the work would worry them to the extent of causing a neglect on their part of the work itself. Of course where work is of sufficient magnitude to employ a special timekeeper a cost record can be kept with accuracy.

3. The cost of unloading material is a very variable one, depending on the amount of traffic passing over the line on which work is being done, on the proximity to stations, on the character of cars material is sent in, etc. The cost of moving a gang to a piece of work also cuts quite a figure when the job to be done is small, as the price per yard is then unreasonably high as compared with a large job.

4. Sand is usually shipped from a sand pit which is owned by the railroad, and the only cost is that of loading and a proportion of the original purchase price of land and cost of stripping. For purposes of comparison it has been placed at 40 cents per yard in the tables given herewith, as this probably represents the cost to the company. In a few instances on the Atlanta Division of the Nashville, Chattanooga & St. Louis, sand has been purchased on the line for a number of jobs at 60 cents per yard, as the company's sand pit is too far from that division to justify shipping it.

5. Lumber is variable on account of the fact that rarely if ever is the entire amount at any one place bought new. Some jobs, however, get a much larger proportion of new timber than others, thus accounting for the wide differences noted in table No. 1.

6. All material is carried company service.

The above conditions, however, prevail to a more or less degree on all railroads, and what is of most concern is: What does it cost to do concrete work under these conditions? The costs herein given are compiled from the work reports of foremen in charge, from the records of material purchased, etc., in the Chief Engineer's office; and while no claim is made that they are absolutely accurate, yet it is believed that they represent the fair average costs of work done under the conditions to be described.

The first exposed structure built of concrete by the Nashville, Chattanooga & St. Louis was an 18-ft. full-centered arch culvert near Paris, Tenn., on the Paducah & Memphis Division. At this point there was a frame trestle 65 ft. high and 1,333 ft. long, which had so deteriorated as to require renewal. The drainage area was estimated to be 3,600 acres; and the bottom was a long, flat one, very sandy—being, in fact, filled with sand from the adjoining hills. The 18-ft. culvert gave a water way of 289 sq. ft., minimum fall, and 162 sq. ft. up to the spring line. The railroad company was not at that time equipped to do concrete work, but had built with its own forces many brick culverts; and it appeared most economical at first to build the structure of brick. However, bids were solicited from outside contractors for a structure of concrete, and that of the Nashville Roofing & Paving Company was accepted. Not being able to get a foundation at a reasonable depth, it was decided to drive piles to assist in supporting the structure and its load. These piles were spaced about 2 ft. 9 in., center to center, under the side walls of the culvert, and were driven with a specially rigged land driver. Ties 8 in. x 16 in., spaced about 9 ft. apart, were bolted to the foundation piles to prevent any possibility of the spreading of the foundation. Louisville cement concrete about 2 ft. deep surrounded the piles at the tops, about 6 in. of the heads of the piles being left exposed to give bond with the side-wall concrete. Paving 20 in. thick was put in, the lower 12 in. being of Louisville cement concrete and the upper 8 in. being of Alsen Portland. The piles and foundation concrete was put in by the railroad company's force. The middle third of the culvert was made heavier than the ends on account of the great weight on the center and the necessity of securing broader footings. Alsen Portland was specified for the main portion of the arch, because full confidence in the American product had not yet been firmly established. No expansion joints were provided in the structure; but vertical cracks have developed since about 50 ft. apart, showing that it would have been well to have made such a provision. The stone was shipped in drop-bottom cars; the sand, in ordinary coal cars; and both were dumped or shoveled from the cars into bins under the trestle. A cement house was constructed at surface elevation, and cement was sent down a chute to it. The mixing boards were also on the surface, and runways were built up as the work progressed. The stone used here was hand crushed in part. The contractors had given to them a large quantity of spalls from a quarry nearby, much of which was too large for the concrete, and this was broken by hand. An itemized statement of the cost is as follows:

		Av'ge, per cu. yd.
Superintendent's salary and expenses, 100 days	$550.00	$0.29
Foreman, 100 days at $2.50 pr day	250.00	.13
Carpenter work	354.65	.19
Mixing and placing concrete	2,209.35	1.17
Hauling material	84.75	.04
Lumber centers, cement house, and hardware	1,215.80	.64
Loading and breaking broken stone	471.00	.25
Sand, 977 yd. at 60 cts. per yd.	586.20	.32
1,360 bbls. Old Dominion cement	2,720.00	2.26
550 bbls. of Alsen cement	1,567.50	...
Total	$10,009.25	$5.29

The volume of concrete in the culvert is 1,894 yds.

Table No. 1 gives a detailed statement of the cost of the more important concrete structures put in recently by the forces of the Nashville, Chattanooga & St. Louis. In order that it may be clear just what conditions prevailed at each place a short description will be given:

Five-foot concrete culvert, Northwestern Division.—This is a full-centered arch culvert built under an open trestle 33 ft. high. The cost of excavation was excessive on account of blasting out much rock in order to secure a straight water way in a crooked ravine. The stone was dumped and the sand was shoveled into bins built on the ground between the trestle bents. The stone and the sand were near the site of the culvert. Cement was brought in wheelbarrows from the cement house constructed for another culvert job 1,000 ft. away. There is a large traffic on this division, and unloading had to be done as soon as the train arrived at the site, regardless of what work was going on. The material was handled to the mixing boards and from the mixing boards to forms in the usual manner by wheelbarrows. The cost of forms per cubic yard is usually considered as varying inversely with the size of structures of similar kinds. By reference to the table it will be seen that the cost here was considerably in excess of the average. Carpenters were held here to work on the other culvert 1,000 ft. away; but as this work could not be begun promptly, they were put to work mixing concrete. This accounts for the high average price for labor per day. The proportions used in mixing were 1 of cement to 5.5 of stone. This is somewhat richer than usual. The items not classified were such as hauling drinking water, cutting a ditch to turn the water, taking out bents of the old trestle and constructing false work to carry the track, and sidetracking cars.

Sixteen-foot concrete culvert, Northwestern Division.—This is a full-centered arch culvert of 16-ft. span built under an open trestle 47 ft. high. The foundation is rock. The cost of excavation was very heavy, because flinty rock had to be blasted to secure the foundation, divert the roadway through the arch, and change the creek channel. The culvert is on an angle of 70 deg. to the track. The middle third of the culvert had the arch ring thickened 6 in. The sand and stone were unloaded into bins constructed between the trestle bents and the cement was unloaded by hand into a cement house constructed at track elevation, being sent from there down chutes to the mixing boards. The rock and sand were handled to and from mixing boards, as usual, by wheelbarrows. The organization of the gang who did the work consisted of a foreman at $3.20 per day, a subforeman at $2 per day, and negro laborers at 90 cents per day, the railroad company paying the board of all, which averaged nearly 20 cents per day. This gang had had considerable experience in concrete work before beginning the job. The proportions, as reported, were 1 of cement to 6.5 of stone. The large volume in the job and the experience of the gang, of course, had a good deal to do with the low cost per yard at which the work was done. The entire cost of the work was only $6.27 per yard, while the cost of the concrete work proper was only $4.96.

Seven-foot-eight-inch concrete culvert, Chattanooga Division.—This is a full-centered arch culvert under a 16-ft. fill. It replaced an old stone box, which was too small. Piles were driven just wide enough to permit of the construction of the culvert, the bank was dug out, and lagging was put in. Part of the stone from the walls of the old culvert was used to build aprons; part of it was hand broken and used in the paving concrete. At the lower end of the old culvert a large hole had been washed out. This was filled up with stone from the old culvert, and paving was put in over it. The handling of material here was quite difficult, as the room for it was contracted. A water box was built lengthwise along the center of the paving to take care of possible rains, and the crushed stone was dropped through on top of the paving and box from drop-bottom cars and then wheeled out so as to give room enough to put up the forms for one side wall and then the other. When the side walls had been brought up to the spring line, the balance of the crushed stone needed to finish the job was dropped on top of the walls and paving and wheeled out. The centers were then put up, and the arch was finished. The breaking of the stone from the old culvert by hand cost 80 cents per yard, and the double handling of much of the material also added to the cost. The total cost of the work was $7.13 cents per yard; the cost of concrete proper was $5.31 per yard. While the average cost per day of labor here was low, the cost of mixing and placing was high. This was largely due to the conditions above explained, but was partly due to the inexperience of the negro laborers employed. The proportions used were 1 of cement to 6.5 of stone.

Twelve-foot concrete culvert, Chattanooga Division.—This is a full-centered arch culvert under an open trestle about 25 ft. high. The foundation was good gravel. One bent of trestlework was taken out, and a long temporary span was put in over the trestle. Bins were built under the trestle for the stone, which was dumped into them from drop-bottom cars. A chute on the side of the fill carried the sand almost to the mixing boards. A battery of water barrels was filled with water from the engine and carried with a sprinkling hose to the mixing boards. Owing to the small height of

the side walls they were carried down straight. The finish of the wings was also somewhat different from the general type of culverts. The mixture here averaged 1 of cement to 5.8 of broken stone—somewhat richer than usual. The organization of the gang was a foreman at $3.20 per day and laborers at 90 cents per day, the railroad company paying the board of all, which amounted to about 18 cents per day. The record made on this culvert was as follows: Total cost of work, $5.93 per yard; cost of concrete proper, $4.96 per yard. Considering the comparatively small volume in the culvert, this is cheap.

Twelve-foot concrete culvert at Doe Creek.—This is a full centered arch built under an open trestle 25 ft. high. It is on a new extension, where there was very little interference from trains; hence unloading material could be done without serious interruption. A solid-rock foundation was secured about 2½ ft. below the surface, the excavation being entirely earth. Stone was brought to the site in drop-bottom cars and dumped through the trestle into bins constructed between the trestle bents. Sand was unloaded into bins similarly constructed. A cement house was built several feet above the surface, and the cement was sent down a chute from the cars to this house. In one corner of the house a hole was cut large enough to drop sacks of cement through. Under this hole wheelbarrows were run, and the cement was dropped into them as needed and wheeled down a slight decline to the mixing boards. A trench pump was placed on an elevated platform and pumped water from the creek into barrels, which were placed at an elevation sufficient to deliver water to the mixing boards by gravity. Mixing boards were placed at each end of the culvert. No negro labor was employed. The foreman was paid $2.50 per day; two carpenters, $2 each per day; white laborers, $1.25 each per day; and the gang paid their own board. The average cost per day labor was $1.47. This was a green crew, which had done only one job of concrete previous to this and that was a different style of structure. The proportion of cement to stone was 1 to 6.1. The total cost of finished work was $5.88 per yard, while the cost of concrete proper was $5.16. The cost of building forms here was larger than it should have been—due to unfamiliarity of the carpenters with the work to be done. Had this item been about the average, the cost of the concrete would have been quite low. This record is good evidence that while concrete can be done with a small percentage of skilled labor, yet intelligent labor is greatly to be desired. White labor was obtained here at a very low figure, and it is quite likely that in other sections more would have to be paid to secure it; but with such a gang well trained, with a foreman thoroughly acquainted with concrete, better work would be done by using white labor exclusively.

Ten-foot culvert, Paducah & Memphis Division.—This is a full-centered arch culvert built under an open trestle 22 ft. high. The average cost of labor per day was $1.59, which is higher than usual, due to working carpenters on mixing and placing. The proportion of cement to stone was 1 to 5.8. The cost of material in the forms was also high, as new material was mostly used. The total cost of the work was $7.13 per yard, while the cost of concrete proper was $5.86 per yard.

STATEMENT OF COSTS OF CONCRETE STRUCTURES ON THE NASHVILLE, CHATTANOOGA & ST. LOUIS.

Items.	Culverts, 5-ft.; N. W. Div.	16-ft.; N. W. Div.	7 ft. 8-in.; Chatta. Div.	12-ft.; Chatta. Div.	12-ft.; Doe Cr.-McMinn Br.	10-ft.; P. & M. Div.	Walls—Abutm't; Col. Branch.	Side, for drain; Jasper Br.	Retaining; Lookout Mount.	Foundation track scales Chattanooga.	Bartow.	Lexington.	Rim walls turntable. Waverly.	Atlanta, Ga.
Cubic yards	210	986	199	292	406	354	310	99	282	78	71	72	41	258
Labor costs: Excavation	$316.30	$639.05	$251.75	$131.15	$140.50	$212.20	$80.00	$50.00	$181.05	$44.70	$65.70	$90.55	.....	.....
Unloading material	48.00	*.....	33.55	54.00	65.15	63.70	*.....	*.....	*.....	*.....	21.40	*.....	*.....	*.....
Building forms	225.25	407.70	65.50	136.80	295.20	217.80	109.90	40.00	308.90	*.....	*.....	*.....	*.....	*.....
Mixing and placing	334.35	1,240.75	345.15	396.05	495.70	597.10	597.90	334.85	385.30	*.....	123.65	184.15	*.....	*.....
Back filling†	102.95	262.85	51.70	148.60	136.25	111.45	21.00	*.....	*.....	*.....	*.....	*.....	*.....	*.....
Not classified	106.75	360.25	59.65	.....	.....	45.85	.....	.....	.....	172.70	58.15	73.25	170.25	832.15
Totals: Labor	$1,133.60	$2,910.60	$807.30	$866.60	$1,132.80	$1,248.10	$808.80	$424.85	$875.25	$217.40	$268.90	$347.95	$170.25	$832.15
Average per yd.	5.40	2.97	4.05	2.97	2.79	3.53	2.61	4.29	3.10	2.79	3.79	4.83	4.15	3.22
Number of days labor	702	1,994	607	726	768	784	573	226	599	128	131	224	134	553
Average per day	$1.61	$1.46	$1.33	$1.19	$1.47	$1.59	$1.43	$1.88	$1.46	$1.69	$2.05	$1.55	$1.27	$1.50
Material:														
Cement, sacks	862	3,749	727	1,179	1,611	1,512	1,352	375	1,117	300	293	400	170	1,062
Value	$456.85	$1,986.95	$385.31	$532.05	$853.85	$801.35	$716.55	$165.00	$558.50	$161.70	$155.30	$212.00	$81.55	$434.60
Sand, cu. yd.	90	468	99	134	188	158	145	45	126	40	32	40	22	120
Value	$36.00	$140.40	$39.60	$53.60	$75.20	$63.20	$58.00	$18.00	$50.40	$16.00	$12.80	$12.00	$8.80	$48.00
Stone, cu. yd.	181	936	181	260	375	333	230	.....	42	75	..	78	37	30
Value	$108.60	$567.80	$101.45	$156.00	$187.50	$166.50	$138.00	.....	$21.00	$37.50	.....	$46.80	$22.20	$18.00
Slag, cu. yd	...	...	...	...	...	...	62	90	208	..	64	..	..	205
Value	.....	.....	.....	.....	.....	.....	$12.40	$18.00	$41.60	.....	$12.80	.....	.....	$41.00
Lumber—value	$166.35	$543.35	$86.35	$125.00	$121.50	$167.05	$171.80	$9.00	$75.00	$20.00	$35.70	$24.40	$12.55	$45.00
Miscellaneous	$20.00	$30.00	.....	$15.00	$77.15	.....	.....	.....	.....	.....	.....	$18.25	.....	.....
Totals—Material.	$787.80	$3,268.50	$612.71	$866.65	$1,253.05	$1,275.25	$1,096.75	$210.00	$746.50	$235.20	$216.60	$313.45	$125.10	$636.60
Average per yd.	3.75	3.30	3.08	2.96	3.09	3.60	3.53	2.12	2.65	3.01	3.05	4.35	3.05	2.47
Grand Totals:														
Labor and material.	$1,921.40	$6,179.10	$1,420.01	$1,733.25	$2,385.85	$2,523.35	$1,905.55	$634.85	$1,621.75	$452.60	$485.50	$661.40	$295.35	$1,468.75
Average per yd.	9.15	6.27	7.13	5.93	5.88	7.13	6.14	6.41	5.75	5.80	6.84	9.18	7.20	5.69

*Separate costs of items thus marked were not kept. †And tearing down molds.

Abutment walls, bridge, Columbia Branch.—At this crossing there was a pile trestle 40 ft. long which required renewal, and it was decided to build concrete abutments and put in 24-in. I-beams, 24 ft. clear span. The main walls were so located as to miss bents of the trestle, and the wings were interfered with at only two points. Three of the wings were flared at angles of 30 deg. to the axis of the culvert, while the fourth wing was flared 45 deg. in order not to interfere with the natural channel of the stream. Bins for the sand and stone were constructed on the slope of the bank, the lower ends of the bins being close to the mixing boards. At the head of the bin a portion of the bank was dug out under the track, and long stringers were put in to carry the track. The rock was then dumped from cars into this opening and from there shoveled into the bins. A cement house was built near the surface, and the cement was sent down a chute from the cars. The forms were simpler than in any of the arch structures heretofore described, and the erecting was done at less cost. However, as the cost of the lumber was higher, it about balanced the labor reduction. As the concrete here was all in straight walls and as the larger portion of the entire volume was concentrated in a small area, with plenty of room for gangways, mixing boards, etc., cheaper work was done than on an arch culvert or a structure where less concrete was put in. However, the cost was no less than some of the more difficult structures. The gang which did the work was green and this was the first concrete they had put in. The organization of the gang was the same as that for Doe Creek. A portion of the excavation here was probably included by the foreman in the item of mixing and placing. The mixture was also richer than usual, being 1 of cement to 5.7 of stone. At Doe Creek the price of mixing and placing was $1.22 per cubic yard, while here it was $1.69—which, on its face, seems to show a decided increase in the efficiency of a gang after practice on only one job. This shows the importance of keeping well-trained concrete laborers on the same kind of work continuously.

Open drain, Jasper Branch.—The old structure at this place was 12 ft., span pile trestle. As it required renewal, it was decided to replace it with a cedar-covered drain, with concrete side walls. The small volume of concrete, the expense of moving to the work, etc., ran the cost up, the total for concrete proper being $6.41, notwithstanding the aggregate used was cheap on account of using slag instead of crushed stone.

Another class of railroad structures where concrete can be employed economically is in foundations for track scales. On table No. 1 are shown the details of cost of several. No itemized statement of the cost of forms, unloading material, drainage work, etc., was kept on these structures; but the total cost, including all these items, is such as to show that concrete is well adapted for the purpose, both in economy and efficiency.

Retaining wall, Lookout Mountain.—Room for storing and handling material at this point was restricted and necessitated additional labor in handling; otherwise the conditions were favorable for cheap work, the structure being a simple one, having its mass concentrated in a small area. Slag was used principally as the aggregate, and old material was used for the forms, thus reducing the cost of mterial. The cost of the entire work was $5.75 per cubic yard. The laborers were negroes, but were directed by an intelligent and experienced white foreman.

A number of rim walls for turntable pits

have also been built of concrete. Table No. 1 gives data of two such structures. The small volume of the work done at Waverly, Tenn., only a portion of the rim being constructed, made the cost quite high. At Atlanta, Ga., a complete rim was built, slag being used as the aggregate; and the total cost here was only $5.69 per cubic yard. The new table put in at this point was 70 ft. long and replaced an old one 54 ft. long. As the rim was built on the outside of the old masonry walls, the space to work in was small; and had masonry been put in, it would have been much more expensive. It was built inside a 40-stall roundhouse, and the turntable was used all the time the new rim was being built.

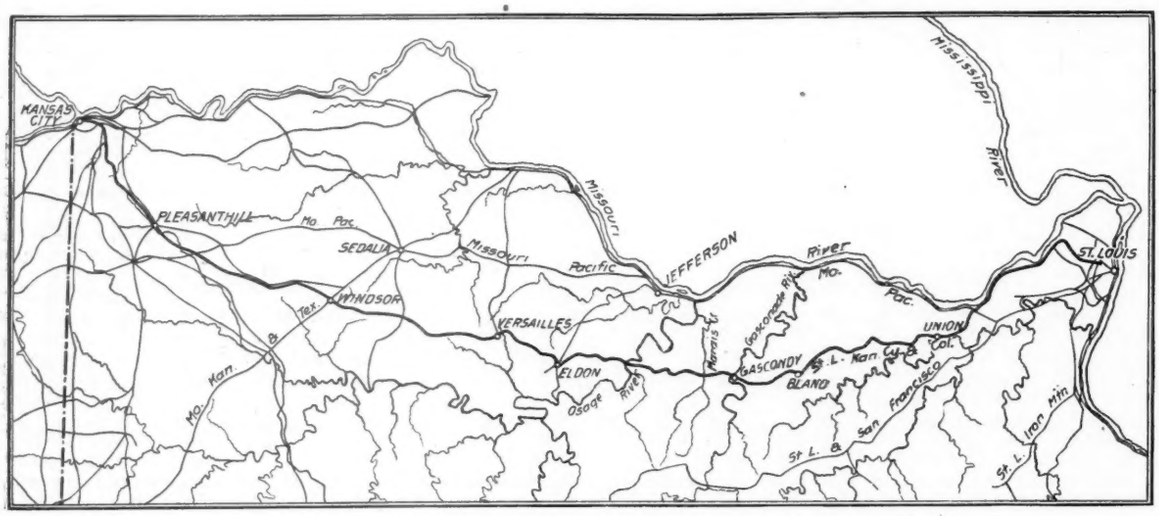
The St. Louis, Kansas City & Colorado.

BY J. L. CAMPBELL, M. AM. SOC. C. E.*

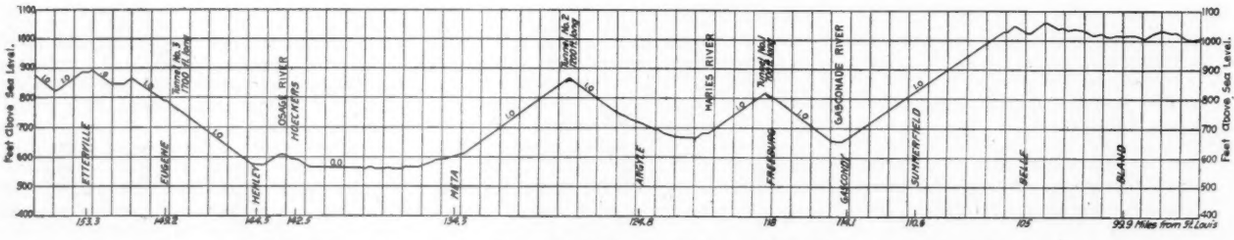
The St. Louis, Kansas City & Colorado Railroad Company was chartered in 1884 to build a line from St. Louis west to Kansas City. The road was built as far as Union, Mo., 60 miles west from St. Louis, and this mileage was operated up to 1901. In 1901 due west from St. Louis over the rough broken country south of the Missouri river and is one of the heaviest pieces of railroad building west of the Mississippi.

When the Rock Island took over the property grading was practically completed as far as Eldon, 159 miles from St. Louis, and on this section the maximum grade had been fixed at 1 per cent. in both directions, compensated .04, with maximum curves of 6 deg. There remained 138 miles to be built through a rolling country and the Gasconade Railway Construction Company was incorporated by the Rock Island officers to carry out this work for the railroad. Mr. John F. Stevens, Second Vice-President of C., R. I. & P. Ry., is president of this construction company, and Mr. W. L. Darling, Chief Engineer of the C., R. I. & P., is vice-president. Work on the partially completed extension and the new construction was carried on with energy after the transfer of the property and track laying was completed into Kansas City last July. Regular trains are now running between that city and St. Louis.

Because of the importance of the new line and the probable future development of a



Map of Central Missouri, showing the St. Louis, Kansas City & Colorado.



Profile of Heaviest Grades on the Line between Eldon and Bland, St. L., K. C. & C.

an extension west to Bland, 40 miles, was opened, and in 1902 a further extension of 14.5 miles to the Gasconade river was completed and construction was begun between that point and Versailles, Mo., 177 miles west from St. Louis. Soon after its re-organization, the Chicago, Rock Island & Pacific in the early part of 1902 began a period of remarkable development and expansion, and one of the first lines acquired was the St. Louis, Kansas City & Colorado. It forms the connecting link between the lines of the Rock Island running east, west, north and south from Kansas City, and the Frisco System at St. Louis and is an essential part of the Southwestern Grand Division of the Rock Island System. The road runs almost

*Chief Engineer, Gasconade Railway Construction Company.

heavy traffic, the location and construction have been along advanced lines and on an exceptionally permanent basis for a new road. In round numbers the grading involved 12,000,000 cu. yds. of pay quantities; an average of 40,000 yds. per mile for the 300 miles. There are four tunnels, 400 ft., 700 ft., 1,200 ft. and 1,700 ft. long, respectively, and all but the second are lined with concrete. The roadbed is unbroken except where necessary to put in bridges for large waterways. Where the grade line gave sufficient clearance all drainage was carried under through concrete masonry arches and there are about 500 of these, varying from 2-ft. to 36-ft. span. For all openings larger than 36 ft., steel bridges have been put in. There are 55 of these structures having spans of from 30 ft. to 375 ft. and placed on concrete abutments and piers ranging in height from 10 ft. to 106 ft. from foundation to coping. The largest bridge, over the Gasconade river, is 1,800 ft. long. Throughout the entire length of 240 miles of new construction there are only three wooden bridges, one of which is a temporary structure at Kansas City, which will shortly be replaced with a steel bridge. The extended use of concrete arch culverts in the new construction has resulted in having an average of only one open floor bridge to every five miles of road and this on a line crossing the drainage at right angles for the entire distance of 240 miles through a region where the annual rainfall is 40 in. About 75,000 cu. yds. of concrete and 4,750 tons of steel have been used in the culverts and bridges.

The roadbed is 18 ft. wide over the shoulder on embankments and 20 ft. and 24 ft. wide in rock and earth cuts, respectively. East of Versailles the old roadbed was narrower than this and six steam shovels were worked on the reconstruction for two years in order to bring the whole line up to standard. The road is laid with 80-lb. rail on rock ballast.

In locating and building the western end of the line from Eldon to Kansas City the maximum grade was fixed at .8 per cent., compensated .03, with 3 deg. curves. On this section a probable density of traffic of one freight train an hour one way was assumed and the following values for the physical characteristics of the line affecting the cost of operation were taken: Cost of distance, $7.20 per foot plus the cost of construction of the distance saved; curvature, $90 per degree; rise and fall, within 25 ft., $42 per foot; rise and fall between 25 ft. and 50 ft. $168 per ft.; rise and fall on limiting grades, $672 per foot; grade crossing with another steam road, $42,000.

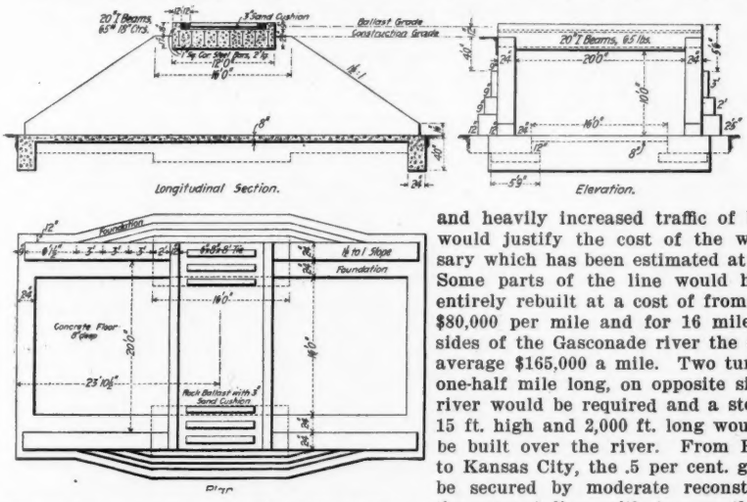
These values were used in determining the details of the location after the general route and characteristics of the line had

Embankment 110 Feet High, St. L., K. C. & C.

Summit Cut at Belle, Mo., Looking East.

been fixed. If the location from St. Louis to Eldon, surveyed before the Rock Island bought the line, had been determined by the values above specified, a much better alinement would have been secured on the eastern division at an expenditure which, though large, would have been justifiable. The maximum curvature might possibly have been reduced from 6 deg. to 4 deg. but anything less than the 1 per cent. ruling grade which was used would not be justified by the amount of traffic now in sight.

The maximum grade of 1 per cent. on the eastern division starts in a cut 50 ft. deep at the summit at Belle and continues down 9 miles to the Gasconade river, which is crossed 90 ft. above low water. The cost of this portion of the line was approximately $60,000 a mile. Twenty miles below the Gasconade crossing, the main line of the 'Frisco (now a part of the Rock Island) crosses the same stream with 2 per cent. grades and 10 deg. curves. It is feasible to build a connecting line across from the 'Frisco to the St. Louis, Kansas City & Colorado, west of the Gasconade river, and to combine the traffic of both roads from that point into St. Louis. Surveys have been made for a .5 per cent. grade line with 3 deg. curves from St. Louis by reconstructing the existing line and building the connecting link to the 'Frisco, but these surveys have shown that the work could not be done without a very heavy expense. The elimination of distance, rise and fall and curvature on such a line would be 9 miles, 350 ft. and 3,800 deg. respectively. Only the combined and heavily increased traffic of both roads would justify the cost of the work necessary which has been estimated at $8,500,000. Some parts of the line would have to be entirely rebuilt at a cost of from $70,000 to $80,000 per mile and for 16 miles on both sides of the Gasconade river the cost would average $165,000 a mile. Two tunnels, each one-half mile long, on opposite sides of the river would be required and a steel viaduct 15 ft. high and 2,000 ft. long would have to be built over the river. From Eldon west to Kansas City, the .5 per cent. grade could be secured by moderate reconstruction of the present line, with two or three exceptions. These improvements are, of course, only possibilities, but in time the increased business may require the changes to be made. The accompanying map and the profile of the line from Bland to Eldon show the relative positions of the two roads and the topography of the country along the Gasconade and Osage rivers.

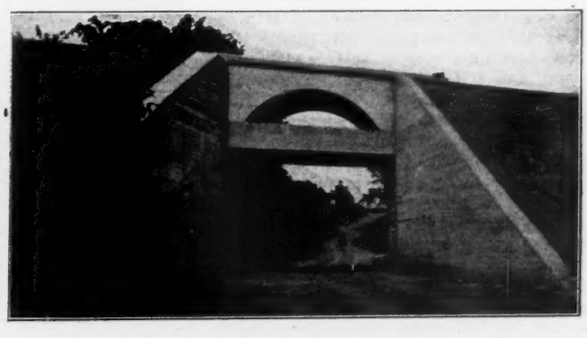


Concrete and I-Beam Solid Bridge Floor.

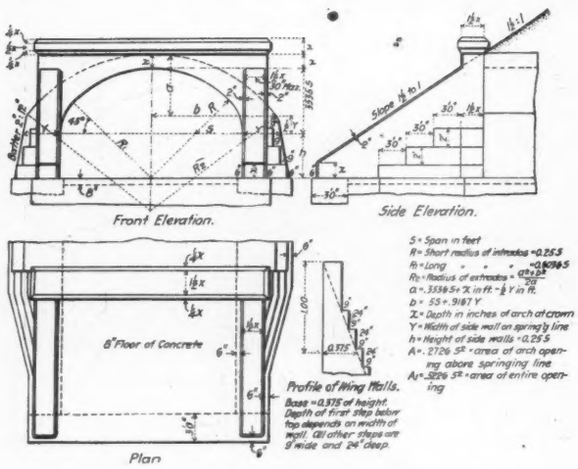
Grading.—On account of the uniformly heavy character of the work, a large part of the grading has been done by steam shovels and 30 of these machines have been employed almost constantly since the construction began. The material excavated consists chiefly of clay, shale, limestone and a conglomerate of clay and disintegrated limestone. Ordinarily, the shale lies beneath the limestone with a strata of clay on the surface. This combination of material is most unsatisfactory for building the roadbed, particularly for making high embankments. In some places along the road embankments 100 ft. high have been made and the great weight of these banks, which are composed of this composite material, combined with the extreme wet weather conditions which prevailed during construction, has caused a great amount of settlement. In some cases serious slides extending 100 ft. and more beyond the slope stakes have occurred. Another cause of the sliding banks is the method used in building them. Most of the high embankments were made by building a pole trestle up to the required grade across the valleys along the center line of the right of way and dumping over the sides the material excavated from adjacent cuts. Banks built up in this manner grow from a central core and the slopes are always loose and more unstable than the center. The bank, therefore, has a tendency to slip out on both sides and the trestle buried in the core aggravates the trouble. It is almost impossible to calculate the additional amounts required to compensate for the settlement which finally takes place, but in doing work on such a large scale, dumping from trestles is the most practicable and expeditious method in the end.

In many of the deep cuts, the limestone is deep under the surface and is overlaid with many feet of clay which is more or less saturated with water. At a number of places this clay has slipped down to slopes of 1 to 3 and 1 to 4 and is still sliding. In two of the worst cuts, after the roadbed had been graded ready for track but before the track was laid, the clay ran in to a depth of 5 ft. above grade. The track was cribbed through this mud and a large force of men put to work cleaning out the slide. The exceptionally wet season following the

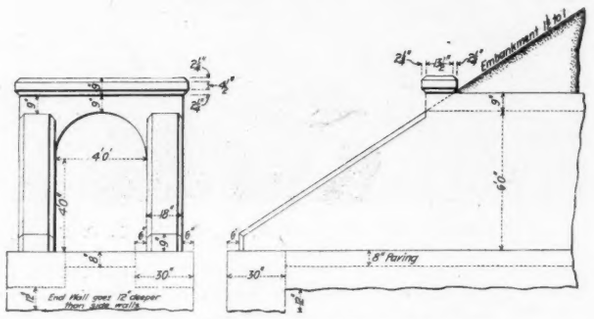
Concrete and I-Beam Solid Floor Road Crossing.



Road Crossing after Grade Was Raised 8 Feet.



Standard Concrete Elliptical Arch Culvert.



Standard Concrete Arch Cattle-pass.

grading was probably the cause of most of the trouble, and there is little likelihood of further interruption of traffic from this cause.

Waterways.—All drainage areas were determined by actual measurement except in the case of the large streams where the catchment areas were scaled from maps of the United States land and geological surveys. The extreme flood discharge per square mile in cubic feet per second was calculated from the formula $Q = \frac{17\sqrt{8{,}000}}{A}$ in which A is the area of the catchment basin in square miles. This is approximately the same formula as that proposed by Mr. J. P. Frizell. Having determined the maximum discharge, the next step was to fix the maximum permissible velocity of flow through the waterway opening which would depend, within reasonable limits, on the character and height of the embankment in the case of a culvert and the nature of the banks and surroundings in the case of a bridge. Low earth banks should, in any case, have a waterway with a sectional area large enough to carry off the full flow at a moderate velocity as fast as the water can reach the opening. A high rock fill will permit of a higher velocity of flow and some backing up of the water. The sectional areas for openings on this work were calculated to give a flow of 7 ft. per second for large streams and up to as high as 15 ft. per second for small culverts under high solid banks. Although the past spring has been exceptionally wet with several rainfalls exceeding 4 in. of water an hour, in no case has there been an overflow or washout. Most of the culverts at such times ran full and some ran under a head of 2 or 3 ft.

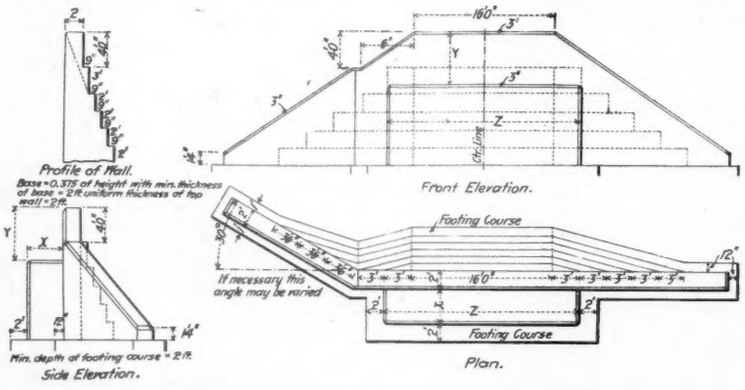
All of the concrete arch culverts of from 5 to 40 ft. span are of one general design, as shown in the drawings, and the dimensions are proportional to the span in each case. The intrados of the arch is semi-elliptical, struck with two radii and having a rise equal to .3535 S, while the extrados is formed by a circular arc. The floor of the culvert is 8 in. of concrete, protected at the ends with a 3-ft. sill extending well down into the bed of the stream. For spans between 2 ft. and 4 ft. a circular arch culvert with side walls 12 in. high was used. The discharge apron in both the large and small culverts is carried out to the ends of the wing walls, which are given a uniform slope of 1½ to 1.

Steel Bridges.—The longest bridges on the line are those over the Osage river and the Gasconade river. This latter spans the valley and the channel of the river and is 1,800 ft. long. It is a deck bridge composed of 30-ft. and 60-ft. plate girder approach spans supported on steel towers with four legs resting on concrete pedestals; two 130-ft. truss spans; one 250-ft. channel truss span and one 60-ft. plate girder end span. The substructure consists of concrete piers sunk to rock foundation for the main spans and concrete pedestals resting on piles for each of the legs of the steel towers supporting the viaduct spans. In view of the ultimate possibility of decay of the pile foundation for these pedestals, the footings were proportioned to limit the load to one ton per square foot. A better construction might have been to omit the piling altogether. The elevation of the rail above low water over the channel is 90 ft.

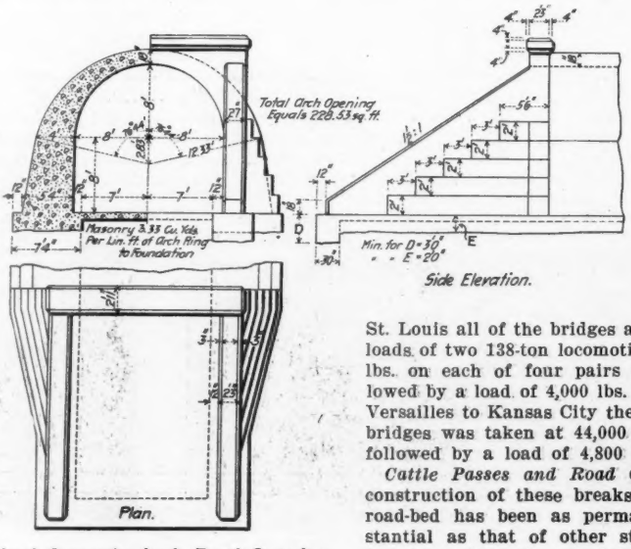
The Osage river bridge is about 1,500 ft. long and crosses the valley about 50 ft. above the ground and 70 ft. above low water. The channel span is a through Petit truss 375 ft. long, and with this exception the bridge is similar in every way to that over the Gasconade. The concrete pier under the east end of this span was sunk to rock 36 ft. below low water with a pneumatic caisson, and is 106 ft. high from foundation to coping. One of the illustrations shows the traveler and falsework used in erecting this bridge.

All of the bridges west of Versailles are deck plate girders with the exception of two crossings of steam railroads which are through girders. Between Versailles and St. Louis all of the bridges are designed for loads of two 138-ton locomotives with 40,000 lbs. on each of four pairs of drivers, followed by a load of 4,000 lbs. per foot. From Versailles to Kansas City the loading for all bridges was taken at 44,000 lbs. on drivers followed by a load of 4,800 lbs. per foot.

Cattle Passes and Road Crossings.—The construction of these breaks in the line of road-bed has been as permanent and substantial as that of other structures. The drawings show the standard concrete-arch



Standard Concrete Abutment and Wing Walls.



Standard Concrete Arch Road Crossing.

cattle pass and road crossing. The cattle pass has a circular arch of 4 ft. span and is 6 ft. high from floor to crown. It is paved with 8 in. of concrete and is quite similar in design to the small culverts used. The road crossing has a circular arch of 16 ft. span with side walls 8 ft. high.

Still another form of concrete work shown in the drawings is the concrete and I-beam span. This can be used for openings where the height of sub-grade is not sufficient to allow the required depth of filling over the crown of a circular or elliptical arch. It is built with the usual abutments, and on these is supported a concrete monolith slab 22 in. deep containing eight 20-in., 65-lb. I-beams, together with corrugated steel reinforcing bars laid close to the bottom surface. The top of this monolith is troughed to a depth of 9 in. and a layer of sand 3 in. deep is spread over the concrete to act as a cushion. The ties are laid on this sand and filled around with rock ballast flush with the top of the sides. One of the photographs shows one of these spans which was put in and afterwards the grade was raised 8 ft. on account of a railroad crossing beyond. An arch was built up over the flat span and the filling put in above the arch without disturbing the original span. The wing walls were built up and cut to accommodate the increased height of the bank.

Tunnels.—The aggregate length of the four tunnels on the line is 4,000 ft. They were all excavated through rock and with the exception of two bad slides due to faulty blasting, no special difficulties were encountered. Three of the tunnels are lined throughout with concrete 18 in. thick. The dimensions of all are the same, being 18 ft. wide and 22 ft. high from top of rail to crown. When the material was soft and dangerous a temporary timber lining was built in as shown on the drawings, and the permanent lining put in afterwards without disturbing it. Expansion joints were provided for the concrete lining where necessary.

Main Span of Deck Bridge over the Gasconade River.

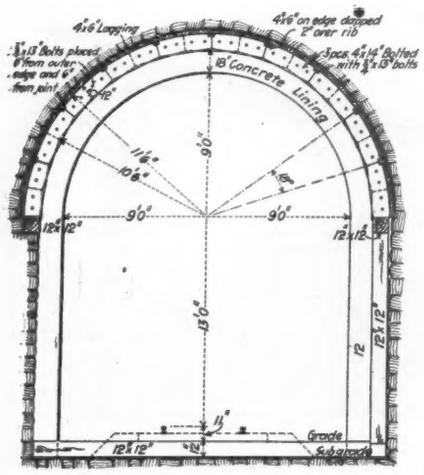
Concrete.—The standard mixture of concrete used in all work on the line was one sack of 95 lbs. of Portland cement, 3 cu. ft. of sand and 5 cu. ft. of gravel or broken stone. Iola cement was used more than any other brand chiefly because of its availability. The stone used was a good quality of limestone broken to 2 in. and less, and mixed as it came from the crusher without screening. All concrete was mixed quite wet and a flat spade was worked in between the forms and the mixture as the concrete was laid. Perfect mortar faces showing all of the grain of the wood in the forms were obtained in this way. Oiled paper was tried as a facing on one of the important bridge piers to prevent the concrete taking an impression of the forms, but the paper wrinkled and the results were not satisfactory.

Regular tests of all cements used were made at the Chief Engineer's office in St. Louis and the average of all tests was more than 500 lbs. for neat bricquettes after seven days ageing. Tests were also made to determine the effects of setting concrete in freezing weather, on the use of salt in mixing during cold weather and on retaining the crusher dust in the broken stone. The results show that concrete was damaged by freezing and by the use of salt. Salt is worse than useless because it will not prevent freezing when the temperature is low enough to damage the concrete in setting. Stone dust added to the cement mortar increases its strength.

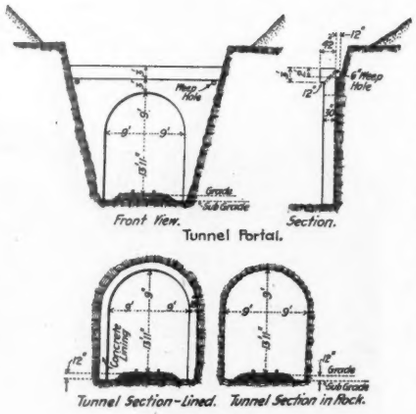
Erecting Main Span of Osage River Bridge.

Track.—The track is laid with Am. Soc. C. E. standard 80-lb. rail, with Continuous rail joints and Harvey grip nuts. All curves are eased on Crandall's spiral, the length of easement being 100 ft. for each degree of curve per 100 ft. on the western division where the roadbed was graded accordingly. On the eastern division where easement was not provided for in the grading, the length of easement was made uniformly 120 ft. The track is being ballasted by the railroad company's own forces with gravel and broken stone, and this work is about 70 per cent. completed. Gravel is being loaded from streams along the line by teams trapping into Rodger ballast cars run out on spurs built down along the banks, and by an "orange peel" bucket dredge which has a capacity of 1,000 cu. yds. a day.

Crusher Plant.—The western end of the line will be ballasted with rock obtained from an elaborate crusher plant located 25 miles east of Kansas City. This plant has only recently been put in operation and has a capacity of 1,000 cu. yds. in 10 hours. The quarry is 300 ft. wide and 1,000 ft. long, and it is spanned with a Lidgerwood cableway with a span of 1,150 ft. carried on two traveling towers 103.5 ft. high. These towers run on a set of seven parallel rails running across each end of the quarry. A double transfer track runs across the center



Concrete and Timber Lining for Standard Tunnel Section.



Details of Standard Tunnels.

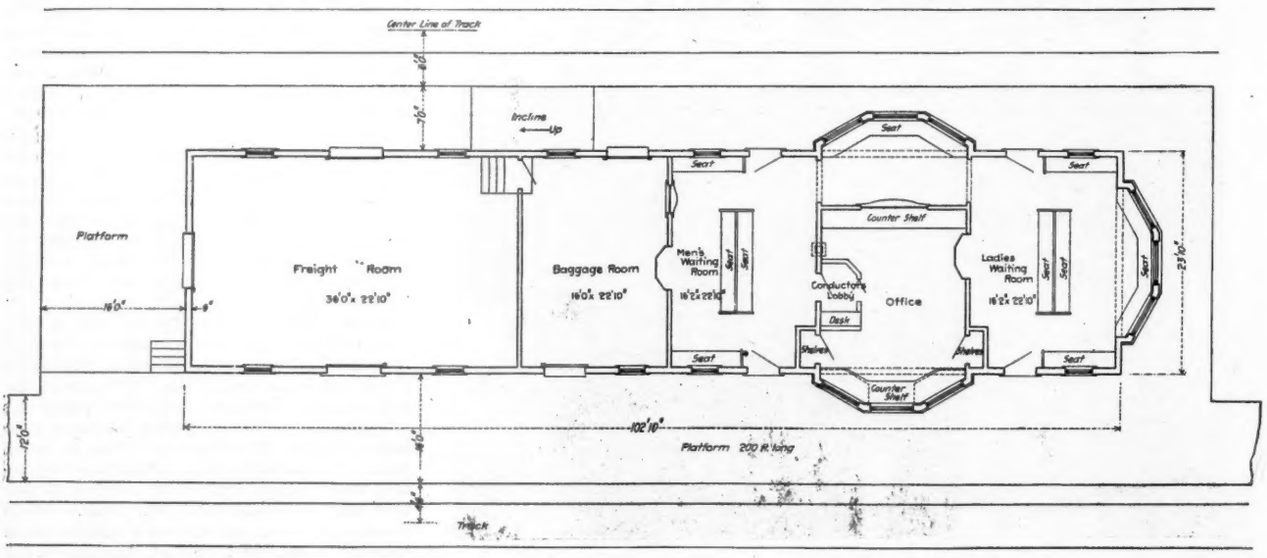
of the quarry, and at one a loading chute or hopper is mounted over both tracks. Stone is taken from out of the ground and loaded into 5-yd. steel skip buckets hung from the cableway. These are then run over the chute on the transfer tracks and dumped. The transfer tracks are on a 4 per cent. grade and at the lower end beyond the quarry they terminate over the hopper supplying the stone crushers. Two Austin 6-yd. dump cars run on these tracks and they are attached to an endless cable which passes around a friction drum at the upper end. As a loaded car runs down from the loading chute it draws the empty car up under the cableway without additional power. In order to bring the two cars alternately over the crusher hopper without using a switch, the transfer tracks begin to converge at a point about 100 ft. away from the crusher and the inside rails cross on a No. 7 frog about 50 ft. away. From the frog on down, the inside rail of one track approaches the outside rail of the other track until they lie side by side with each other and only about 5 in. apart. The cars are dumped automatically and one man at the friction drum controls all their movements.

In the crusher house there is an Austin No. 7½ tandem crusher and a No. 5 crusher which deliver the broken stone on to a bucket conveyor which carries it up to the screens over the storage bins. One loading track runs under the storage bin and another runs alongside of it so that two cars can be loaded at one time if necessary. These tracks give ample storage capacity for cars and operate by gravity so that cars can be dropped down as needed by one brakeman without the use of an engine.

Water Supply.—There are 16 water stations on the line exclusive of St. Louis and Kansas City. Water is pumped from streams at three stations, from deep wells at four stations, from artificial reservoirs at four stations, and at three stations the tanks are kept full by a gravity supply from reservoirs. At Union, water is drawn into the tank from the town water mains. The most interesting feature of this part of the construction work is the artificial reservoirs that have been built. These range in area from 10 to 25 acres, are from 16 to 23 ft. deep and have a storage capacity of from 20 million to 55 million gallons of water. The dams are all made of earth with carefully built puddle cores and slopes of 2 to 1 and 1½ to 1. With the exception of the dam at Windsor all water slopes are paved with stone. All of the spillways, except one, are cut through solid rock around the ends of the dams or are in solid masonry outlets through the dam. They have been carefully designed and proportioned from known areas of watershed and maximum rainfall, and the depth of the discharge stream is limited by giving the proper area of cross-section to the opening.

In the case of the reservoir at Windsor, a highway immediately below the dam made it desirable not to divert the water from its natural channel and accordingly a 15-ft. concrete arch was built through the dam and a heavy concrete floor laid in the barrel. The floor and wings of the arch were extended in under the reservoir a few feet and a square well was built up to the flow line of the reservoir by carrying up the head wall, the wing walls and a cross wall to close the front opening of the wings. Concrete pillars 4 ft. high were built up on the four corners of this well, thereby making four weirs each 15 ft. long. The length of these weirs was determined by limiting the depth of water flowing over to 4 ft. and applying the Francis weir formula for discharge. The maximum depth flowing over up to the present time has only been 18 in. The well walls are 2 ft. thick and are reinforced with steel rods. There has been no leakage through the concrete except at one point where there is a slight trickling.

Water Tank and 40-Pocket Coal Chute at Eldon, Mo.



Plan of Combination Freight and Passenger Station for Small Towns.

This reservoir has a watershed of 1¼ sq. miles, and the depth under normal conditions is 16 ft. An overflow essentially similar to the one described has also been constructed in the dam at the Medford reservoir at which place the railroad embankment, properly widened and strengthened, forms the dam.

The drainage area of the reservoir at Pleasant Hill is so small, being only 210 acres, that the capacity (55,000,000 gallons) was made correspondingly large in order to retain the greater part of the run-off in wet seasons and all of it in dry seasons. It is now approximately half full and is slowly rising, as there are two springs discharging into it which flow constantly and which during a dry season will almost compensate for losses by evaporation.

In the three gravity reservoirs at Argyle, Henley and Pleasant Hill, the water is conveyed under the dam to the water tanks (situated from a half mile to 1½ miles away) through concrete intakes in the reservoirs and cast-iron pipes running under the dams to the tanks. Just below the dams there are concrete valve chambers containing two gate valves and a blow-off pipe for cleaning out the supply mains. Automatic check valves are provided at the tanks which stop the flow of water when the tanks are full. No attendant is needed and the cost of operation is reduced to nothing.

The water tanks are standard 50,000 gallon wooden tubs mounted on steel towers 25 ft. high. They are set 25 ft. inside the station ground limits opposite the standpipes and are connected to the latter by 14-in. cast iron pipes. The standpipes are of the Sheffield pattern with 12-in. spouts and are set between the main line and the passing track, 250 ft. from the center of the depot building. The high elevation of the tank and the large standpipes give a flow of water with the valve wide open that is greater than can pass through the ordinary opening in the top of the tender. At all of the water stations where water is pumped, Fairbanks-Morse gasolene engine pumps have been installed. These pumps are of 8, 10 and 15 h.p., depending on the work to be done and the minimum capacity of the plants is 6,000 gallons an hour.

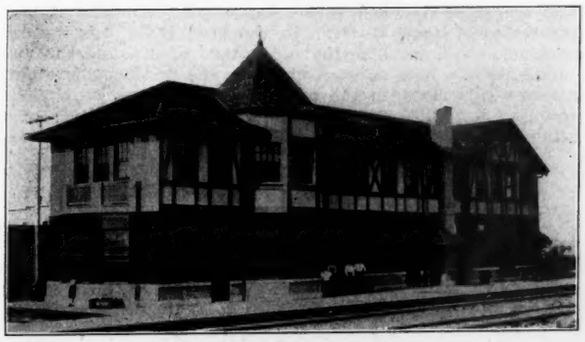
The whole scheme of water supply for this line is probably unsurpassed by that of any other road in the Mississippi valley both as to quantity and quality. The stations have been arranged so that the distance between tanks varies from 12 to 22 miles.

Coal Chutes.—Five coal chutes have been built along the line. The chute at Eldon has 40 pockets, 20 on each side, and those at Union, Belle, Windsor and Pleasant Hill have 20 pockets on one side only. These chutes are designed to haul full car loads up 20 per cent. inclines by means of 25 h.p. Otto gasolene engines, and the coal is dumped into storage bins feeding the service pockets. One of the illustrations shows the water tanks and coal pocket at Eldon.

Station Buildings.—The station buildings along the road are much in advance of those usually built on new lines. Two of the stations are shown in the photographs and one of the drawings shows a plan of the standard station for small towns. At points where suitable houses cannot be rented the stations are built with living rooms in the second story for the agent.

Shops.—No shops have yet been built but ultimately engine terminal facilities will be provided at St. Louis. For the present the Rock Island shops at Kansas City will be used for repairs to rolling stock.

Contractors.—Reichardt & McCarthy did the grading from Union to Belle, 45 miles. H. F. Balch & Co. graded the road from Belle to Versailles, 72 miles, and Stubbs, Flick, Johnson Construction Co. finished the grading from Versailles to Kansas City. A. J. Tullock and the American Bridge Company built and erected the bridges. J. H. Roberts laid the track from the Osage river to Kansas City, and the railroad company's own forces laid the remainder of the track, did the ballasting and built the reservoirs. Fairbanks, Morse & Co. built the water stations, John Volk & Co. built the coal chutes, and A. J. Gorg erected the station buildings.



Station at Eldon, Mo.

Standard No. 1 Station at Windsor, Mo.

International Engineering Congress.

(*Continued from page* 450.)

SECTION E—MECHANICAL ENGINEERING.

Col. H. S. Haines presided over the meetings of this section. On the first day the discussion was on the paper by Mr. J. O. Handy, chief chemist of the Pittsburg Testing Laboratory, on the Purification of Water for the Production of Steam. This paper considered methods of purification under two classes, mechanical and chemical, and particularly with reference to feed-waters for locomotive boilers. A number of written discussions were read dealing with the efficiency of the stirring apparatus used in the continuous method of chemical purification and the tendency of feed-water to cause foaming when it is treated with alkaline reagents.

Mr. A. McGill, Ottawa, Can., referred to the difficulty of maintaining a perfect solution containing no floating particles in the tanks. These floating particles become incrusted with a hard insoluble coating, and the only method of breaking them up before entering the boiler is by prolonged and violent mechanical agitation. This breaks up the coated particles and allows the chemical reagents to act on the impurities, so that they can be precipitated in the settling tank in the form of a sludge. The chief cause of foaming with water treated with alkalines is the lowering of the surface tension of the liquid by the solution of soda salts. Caustic soda produces the most foaming action, and silicate of soda, carbonate of soda, sulphate of soda and chloride of soda produce lesser amounts in that order for a given strength of solution. All boiler water under pressure is in a turbulent state, and when the throttle is opened the pressure is momentarily lowered, the superheated gases in the water immediately lift the water to an amount depending on the resistance of the surface tension, and any substance in solution which lowers the surface tension will cause foaming. The only relief from waters containing large amounts of soda, lime and magnesium appears to be by the use of some salt of barium. Crystallized barium hydrate costs about $30 a ton, and for bad water about 15.2 lbs. of the hydrate is required per 1,000 gallons.

Mr. F. B. Leopold, Chicago, Ill., in a written communication, took up the comparative advantages of the continuous and intermittent processes for treating feed-water chemically. The intermittent system is to be preferred (1) for plants having a capacity of less than 50,000 gallons of water per day and situated where economy of space is no object. (2) For plants of any capacity when in charge of unskilled labor and space permits. (3) For plants of any capacity regardless of supervision when the water is variable in character, as for example river water. (4) For plants where the consumption is variable or considerable elasticity in the output is desired. This type of plant is generally used in industrial works. The cost of installation of small plants working on the intermittent system is less than for continuous plants, and the cost of attendance is also much less. In a continuous plant the regulating devices are easily deranged in small installations, and when treating variable water they must be manipulated constantly to provide the proper quantities of reagents, and to do it properly the tanks would have to be completely emptied. To do this would require several hours; but, on the other hand, with the intermittent system each tank is treated individually to meet its requirements and changes in the character of the water can be provided for immediately and with absolute accuracy by supplying just the right quantities of reagents. Where large quantities are used during short periods of time, a continuous plant must be installed with a capacity equal to the maximum demand for water. An intermittent plant, however, has one tank of settled water always in reserve to carry over the maximum demand. The size of the plant can therefore be determined by the average demand.

Continuous plants are used to advantage: (1) Where space is limited. (2) Where the water softening plant is located at a point some distance from the point where the water is to be used and the output must be pumped. (3) Where the water to be purified is constant in analysis as many well

waters are. (4) Where the water to be purified can only be supplied at about the rate of purification. (5) Where the plant is in direct charge of an operator with some technical and chemical knowledge.

Continuous plants are particularly adapted to installations where the water supply just about equals the consumption. Under these conditions, except in the case of very large plants, an intermittent system would require a number of extra tanks, and the cost of installation and attendance would in most cases be much greater than for the continuous system. For railroad water purifying plants the continuous system is probably the most satisfactory and economical, because the conditions are generally similar to those outlined above.

Adjustable Stay-bolts.—Mr. O. Busse, Locomotive Superintendent, Danish State Railways, Copenhagen, read a short paper on this subject. He said in part:

"Tube-sheets in locomotive fire-boxes are stretched by the frequent rolling of the tubes, and if a tube-sheet is fastened to the crown-sheet, which again is stayed to the outer shell of the boiler, the stretching of the tube-sheet will cause a bending in the flange which in time will lead to fractures. Several forms of stay-bolts have been tried which are intended to allow the tube-sheet to stretch, but most of them are useful only when there is no steam in the boiler. As soon as steam pressure is raised the top of the fire-box will be pressed in just as far as the stretching of the tube-sheet had brought it before, and fracture of the flange will commence.

Much ignorance exists as to the effect of expansion in boiler tubes in plates. The writer made a stay-bolt supplied with an extension which passed through a gland screwed in a socket and acting on a lever with a proportion of 1 to 6. By means of this device it was possible to measure the displacement of the fire-box sheets. A few minutes after the fire was lighted the pointer showed 3 mm., answering to a displacement of the sheet of 0.5 mm., and afterwards it slowly rose to 5 mm., where it remained stationary until steam pressure began to rise. With a steam pressure of 21 lbs. the pointer indicated 3 mm. or 0.5 mm. displacement, and then fell slowly back to 1 mm., when the full pressure of 185 lbs. was reached. After the boiler had cooled down the plates resumed their normal position. This experiment showed that it is not necessary to use flexible top-stays to equalize the expansion due to heat; but it is only necessary to take up the extension of the tube-sheet caused by rolling the tubes.

A new arrangement designed by the writer and introduced on the locomotives of the Danish State Railways, not only allows for the stretching of the tube-sheet during the heating of the fire-box, but also gives a means of shortening the stays in proportion to the stretch of the tube-sheet every time the tubes are rolled when the locomotive is in the shop for repairs. This form of stay is used in the first row or first and second rows of stay-bolts. The bolts are screwed into the top-sheet and are free to move in a socket which is secured in the outer shell of the boiler. A nut rests on this socket, by means of which the stay-bolts may be shortened up each time the tubes are rolled. To prevent leakage around the bolt and socket, a cap is screwed on top the socket with a millboard washer underneath. To allow for the stretching sideways in these stays, the nut is made with a spherical bearing surface. Where it is not possible to get the side stays at right angles to the plates the stay-bolts are riveted over after they are screwed into the fire-box sheets, and for this purpose the outer end of the stay on which the holding on is done is provided with a long threaded nut.

The Paris, Lyons & Mediterranean is using stay-bolts very similar to these, but they are only applied to boilers with flat crown-sheets.

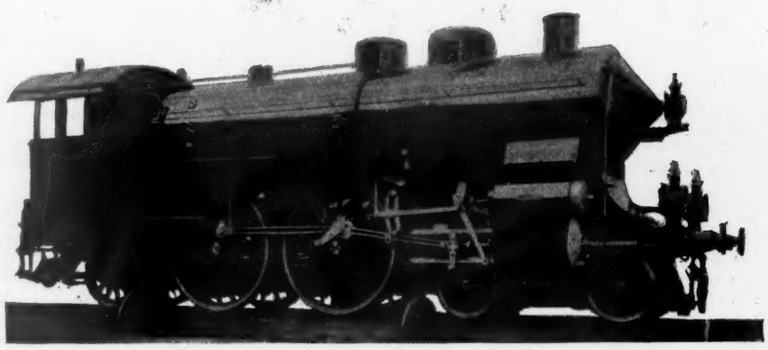
Abstracts of the discussion of papers in the other sections will be continued in a subsequent issue.

New Compound Locomotives in Bavaria.

BY CHARLES R. KING.

It is interesting to note how surely, if slowly, the main features in American locomotive construction are incorporated in the practice of the railroads of the European Continent. In the boilers, for instance, the old smoke-box has long been completely replaced by the cylindrical smoke-box and the circular flue sheet. More recently conical boiler rings, and wide fire-boxes, with or without such conical rings, have had many applications, and the various American plans for supporting the boiler on its frame have been imitated. The American system of riveting the plates has in many instances been employed. Boiler accessories of American origin have an extended application. The cab for the enginemen has been slowly modeled after the American prototype but with improvements thereon. In the engine itself, improvement of detail. The American locomotive is always considered the pioneer, and in its advance towards those improvements in construction necessitated by its size alone, it is hardly to be expected to possess the refinements of detail or combine the elegance of design which is so much considered in countries where fine calculations and shop labor are neither of them such expensive items as in the United States.

The locomotives here illustrated represent, save for the bar-frames, the most approved and latest practice of Continental Europe. They have four cylinders, compounded, and all placed in the line of the smoke-box saddle with which, and the valve-boxes, they are cast in two separate pieces and bolted together at the middle line. The inside high-pressure cylinders drive on the crank-axle of the forward pair of drivers and the outside low-pressure cylinders drive on crank-pins outside of the same pair of wheels, the angle formed between each of the cranks of the same group being, of course, 90 deg. This disposition of the cylinders (due, originally, to Monsieur E. Sauvage, of the Chemin de Fer du Nord, France, as exemplified in his compound locomotive exhibited at Paris in the year 1889) does not combine that advantage of dividing the motor stresses which it was first sought to obtain in the compound locomotives of Mr. Webb or of the later French locomotives of the "Nord"—which only differed from Webb's by



Four-Cylinder Compound 4-4-2 Locomotive for the Bavarian State Railroads.

piston-valves for both high and low-pressure cylinders have recently had extended applications and American experience in regard to these valves is still closely watched. Large groups of cylinders cast in two pieces are now assembled in the American way. In the rolling gear, four-wheel trucks or pilots have become universal and the American lateral swing frame has been given a very fair trial in the eastern countries of Europe, and now, in the last few months bar frames have been adopted. In the use of steel castings, also, for various parts of the motion and wheel-work American practice is much followed. A mere detail, but which affects greatly the superficial appearance of the locomotive, is the abandonment of wheel-covers and "splashers" by many progressive railroads of southeast and central Europe. This has been due to the raising of the boiler very high according to the American precedent.

But one detail of the American locomotive which, if adopted, would retrograde European advance by 60 years or more, is the old-fashioned Stephenson or "Howe" valve-motion and its antiquated eccentric gear. The Walschaerts' (Belgian) gear, although originated many years ago, represents all that modern science can do for an excellent distribution combined with every-day practicability. Even where American "notions" have been finally adopted it has nearly always been with a very distinct the addition of a fourth cylinder. But the Sauvage arrangement is now at last definitely adopted in Europe as being the most practical of the two methods of construction since the principal objection to the excessive fatigue in a single driving axle has been met by the provision of a stronger type of crank-axle with an oblique arm between the two half-webs of the cranks. In the locomotive illustrated the crank pins are hollow and the oblique arm is of a rectangular section. The forgings for the crank axles are usually obtained from Krupp's. At Krupp's these may be seen forged from an ingot of nickel steel, the mass being first shaped in one plane, and then, when completed, simply given a quarter twist at one end to obtain the angle of 90 deg. for the crank pins. This type of axle renders it possible to forge the faces of the crank-arms or half-webs, which is an impossibility with ordinary double-cheek cranks. With these latter it is usual at Krupp's to forge a solid block for each "throw" and to form the two cheeks by running a circular saw into the block as far as the bored-out portion near the future crank pin. The oblique-type axle is also largely used on the Continent for locomotives of the so-called "French" type, i.e., Webb modification.

The foregoing details will be of interest to those American builders who may find it an advantage to construct engines with inside cylinders, the inside cranks and the valve

gear of Walschaerts' being the only important difference to which the American maker is not accustomed.

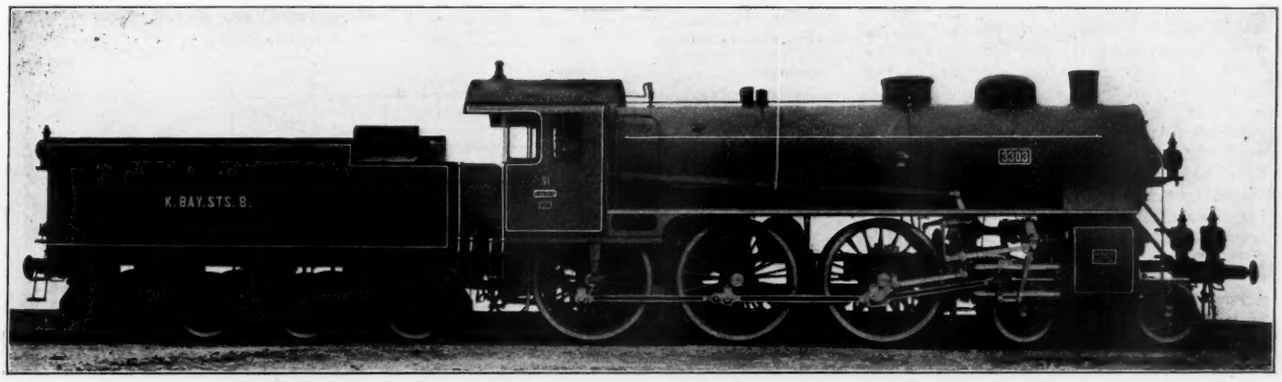
In these new locomotives each cylinder is provided with a piston-valve giving internal admission, those of the high pressure, inside the frames, being driven indirectly from the rocking shaft worked by the upper end of the advance lever. The customary practice of allowing a later cut-off in the low pressure cylinders is possible with this arrangement, but not at the will of the engineman as is the case when two sets of valve gears are used. In some countries (Saxony for instance) two sets of valve gears were originally employed, with separate reversing gears for each, for locomotives having Webb's first arrangement, but after ascertaining the most economical ratio of cut-off for the low pressure cylinders the double reversing gear was abandoned. Likewise all over the European Continent, excepting in France, one set of valve gears for four valves is now considered to be the best practice. In Austria the valve travel is the same for all four valves, but the h.p. and l.p. cylinders have a volume ratio of 1 to 3. In Italy the ideal arrangement has been made a great success: that is, of only two valves for four cylinders yet with the cut-off *variable between the two groups of cylinders* and only one reversing screw, so that the engine is practically as simple in use as a single expansion locomotive.

The especial feature to be noted in this latest type of compound, similarly with the greater part of Continental locomotives, is the lightness of all the parts in the motion. There is more of utility to be learned from these details than the mere quotation of principal dimensions, which usually teach nothing. The necessity for producing very powerful locomotives with a minimum of useless dead-weight in the revolving or reciprocating parts is due on the European continent to the small weight which is permitted upon the axles—about 16 metric tons per axle in France and Germany and 14½ tons in Austria and Italy. In consequence, every part is made with the lowest weight that it is possible to scheme, and while in the United States and England the metal is "run" into a locomotive without the necessity to closely consider every pound of it, the elimination of mere dead weight is, on the contrary, always of the greatest importance with Continental locomotive designers. The locomotives under consideration are limited to 16 tons per axle. The finish of all the working parts is such that could not be excelled elsewhere. The boiler pressure is 205 lbs. and 235 lbs. per sq. in. for the six-connected and four-connected respectively, and the boiler work is very thorough, as evidenced by the tightness of the joints even at the mud ring, whereas some nearly new American locomotives in Europe have been seen standing in a pool of water caused by leaky joints while the actual boiler pressure was not half those quoted.

The forged bar-frames of these locomotives are finely milled and slotted over every inch of their surface equal to the finish of the best American motion-work, and the whole of the connections to the frames are fitted with the closest accuracy. This expensive work may be criticized—as to its absolute necessity, but it is the regular Continental practice to finish elaborately. Even the tires are scrape finished to a brilliant surface that, in common with all the machinery, is kept up in service and contributes some to the sense of order, method and cleanliness of the men to whom the locomotives are entrusted. Considered as a whole, with a view to harmony of design these beautiful new machines have, for the time being, no rival in Europe. There is not a single part in them that is superfluous, as was too commonly the case with Continental locomotives of 10 years ago. There are no outside steam pipes as in French locomotives, and yet the steam pipe has a minimum length to reach the high-pressure cylinders. The sand-box, always unsightly upon any locomotive boiler, is rather less hideous here than the American sand-helmet. The chimney can be extended whenever the constructive gage permits this upon favorable stretches of line; but the extension is fixed and cannot be regulated from the footplate. The smoke-box door is novel, being of cast-iron. A cast-steel bracket bolted to its lower contour carries the headlight. In the 6-10 series (European denomination) the front-end frame struts are of American type (round section), but in the "4-10 connected" series the front ends of the frames are stiffened with flat plates with handsome effect—a compromise with the usual plate-frame ends. The boiler center stands about 9 ft. 6 in. from the rail level, and access to the high smoke-box door and front end, from the ground, is provided by four cast-iron steps threaded upon a vertical hand rail on each side of the engine. Cast-iron treads carried on wrought iron rods is the form of construction employed for the other steps. The arrangement of the link radius rod, and its short extension to the lifting link, is novel and well-designed, and by it all torsional stresses are very simply avoided. Wherever an oil cup is necessary it is milled in the rod itself. Brakes are provided for all the wheels in both types of locomotive, the blocks of the front truck wheels being operated direct by the air-brake cylinders.

In the cab there is ample working space, although the fire-box occupies a large part with its sloping back plate. The throttle handle is of the low-reach pivoted pattern, with the common European traversing movement, yet provided with the American spring latch and a finely-notched quadrant. There are wind-screens fixed vertically outside of the cab for use whenever it is necessary to look around the cab sides. Gates are provided between the engine and tender. The tenders are extra large, carrying seven tons of coal and 21 cubic meters of water (21 tons). They have side fillers at the front end so that the fireman can handle the crane hydrant from the footplate and see the height of the water in the tank at all times. The tender trucks are of German standard construction with plate frames. In common with nearly all Continental locomotives these are fitted with tachographs of the Hausshalter model, showing the speeds attained and recording them. The use of a tachometer of great precision is held to be of first importance by European railroads where individual guessing at train speeds would not be tolerated. The "clock" is fixed in the engineer's side of the cab and is operated by the rear driver on the right-hand side in both types of locomotive.

These engines were designed and built by the firm of J. A. Maffei, of Muenchen, Bavaria, to conditions laid down by the chief of traction of the Bayerische Staatseisenbahnen at Muenchen. Ten have already been built and have just been put into service, and 25 more are on order. The maximum gradients of the Bavarian State Railways run up to 1 per cent., and as the country is, in general, hilly the definite type selected for the second order will undoubtedly be the 6-10 connected engine, which is better suited for the light axle loads permitted and for heavy trains. The 4-10, or "Atlantic" pattern, can traverse minimum curves of 180 meters radius, and the 6-10 connected type is also required to pass curves of an equally short radius, the rigid wheel base of each locomotive being 4½ meters. The six-connected engine has drivers 187.0 mm. in diameter, and the four-connected engine drivers are 2 meters in diameter. The latter engine with a boiler pressure of 16 atmospheres has a calculated tractive effort of 5,300 kilograms, while the six-connected engine, with the lower pressure of 14 atmospheres and cylinders 5 millimeters less in diameter, has a tractive effort of 6 metric tons. The high-pressure cylinders are 340 mm. and 335 mm. diameter in the two engines respectively, and the low-pressure cylinders are 570 mm. in diameter in both, the piston-stroke of each being the same, i.e., 640 mm. Both types of engines have an equal grate area of 3.28 square meters, but there is a little difference in the fire-box heating-surface, viz.: 14 square meters for the six-connected engine and 14½ square meters for the four-connected engine. This latter has a total heating-surface of 205½ sq. meters (191



Four-Cylinder Compound 4-6-0 Locomotive for the Bavarian State Railroads.

meters from 283 tubes), and the six-connected engine has a total of 210 square meters of heating surface (196 square meters from 283 tubes). The four-connected engine weighs empty, in metric measure, 61½ tons, and the six-connected engine 62.2 tons. Both weigh about 68½ metric tons in full working order. The first has, beneath its driving tires, a load of 32 tons, while the six-connected has 47.8 metric tons available for adhesion. (A metric ton is about 10 per cent. more than the American standard.) The tenders both weigh 26 tons empty and 54 tons full. The heavier of the two engines therefore weighs with its tender, when full, 135 U. S. tons. These engines are to burn the usual German soft coal from Westphalia.

Cost of Ditching Cuts and Widening Embankments.*

There is not only little published bearing directly on this subject, but statistics regarding costs of work actually done are seldom available, where all the details connected with the work, such as length of haul, kind and condition of material, number of men employed, number of yards removed, lost time through various causes, wages of men, yards handled per train, etc., are known, or, if available to a few, such statistics are not worked up into such shape that they can be presented in a complete and simple form to aid in properly determining the best method to pursue in any particular case.

With a view of placing such information in a convenient form, and also to enable one to see at a glance the effect on the cost per yard of various changes in the number of men, etc., two diagrams (Figs. 1 and 2) have been prepared, one showing the estimated cost per cubic yard for a haul varying from nothing to 7,500 ft., and the other from nothing up to 15 miles. The latter (Fig. 2) can be used to advantage only in determining whether it is cheaper to make a long haul from the point where ditching is being done, than to waste the material obtained from ditching and obtain the material for widening banks from a more convenient location. The former being to a larger scale, shows the relative cost by various methods in better shape, and is, consequently, the one considered in this discussion. Both diagrams are based on the same unit prices, and have been prepared from estimates, after consulting "Trautwine's Pocket-Book," Gillette's "Earthwork and Its Cost," Camp's "Notes on Track," and Tratman's "Railway Track and Track Work," the results being compared with actual costs where such have been available with all conditions known. As it is seldom that ditches are cross-sectioned, in order to know beforehand the exact number of yards to be removed, it is not expected that the diagrams will assist very much in estimating what the cost of ditching a certain cut will be, but if they are fairly accurate they should show very closely how the work can be handled to the best advantage after the estimate is made, and their careful study may give suggestions of value.

In order to make this report as concise as possible, the detailed estimates from which diagrams were prepared are omitted, but are included in an appendix, so that the work may be checked in detail.

By examining this diagram (Fig. 1) it will be seen that the cheapest method of ditching where the material is to be used in widening embankments, and where such work is not done by simply casting across one track, is by a machine ditcher, provided the machine is so designed that it can load and dump 5 cu. yds. in not to exceed 2½ minutes, exclusive of running time, and can be operated by three men besides the train crew, and if the conditions are such that such a machine can be used up to a haul of some 1,200 or 1,300 ft. in very fair digging, or up to some 1,900 ft. in bad, wet digging. From this point on a properly designed machine ditcher, so arranged that it can load a full train of material, used in conjunction with a plow and cable or other method for quick unloading, can be worked most economically. In both these cases of machine ditchers, it is assumed that the machines will be used enough each year to bring the cost for interest and depreciation down to the estimate given in the appendix, the number of yards handled having to be greater than estimated in case a more expensive machine is used than estimated on. Some further notes in regard to machine ditchers are given near the close of this report.

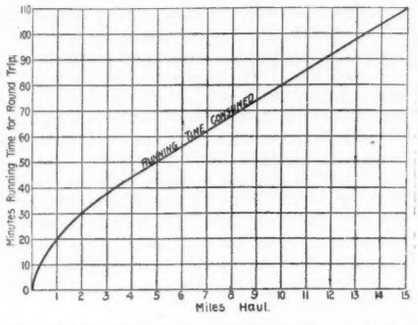
In case a machine ditcher is not available, a study of the diagram will show the relative cost per yard by various methods, provided the traffic is such that the actual working time of work train is only about six hours out of 10 hours the men are assumed to work each day. In discussing the diagram, each method will be considered separately as follows:

By Team Work.—On light work, banks can be widened very economically with teams and scrapers. This method can also be used to widen the base of heavy embankments, the filling being afterwards completed by work train or other means. The filling being compacted by the movements of the teams over it is less liable to settlement and unites closer to the old bank than by other methods. Work of this kind is usually let by contract, the price being from 14 cents to 25 cents per yard.

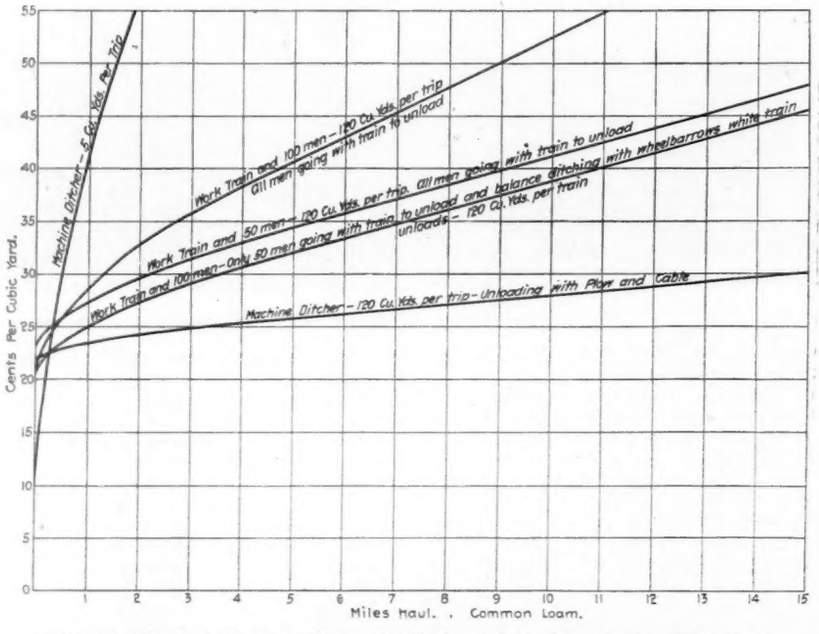
By Casting.—The cost of ditching by casting may in fair digging be taken at 10 cents per cubic yard, where one cast will place the material in a suitable final location. If necessary to use one platform by which the material can be raised 6 ft. with the first and 4 ft. with the last handling, in order to place it far enough from the edge of the cut, the cost for such material will be increased about 6 cents per yard, or a total of 16 cents per cubic yard. A description of a simple portable platform is given under the heading "By Work Train and Hand Loading." In both of these cases the material cannot ordinarily be used to advantage in widening embankments.

By Wheelbarrows.—By this method the material excavated may be used to widen embankments, if conditions are favorable, and the cost is practically a constant to which a uniform addition is made varying directly with the length of haul. For fair digging it will be noted that casting is cheaper than any wheelbarrow work, and that casting with one platform is about the same cost as wheeling 125 ft. with wheelbarrows. If the material is merely to be carried across three or more tracks, where the traffic is so heavy that it is not desirable to lay gangways across the tracks, on account of safety, very fair results can be obtained by constructing boxes with two handles, similar to the handles on push or hand cars, on each end, and have two men carry each box across. This method, however, is more expensive than wheeling.

By Push Cars.—As it is necessary to protect push car work by flagmen the greatest economy by this method will be obtained by working as many men with two flagmen as can be worked to advantage. This is indicated by the three dotted lines showing 4,



Estimated Time for Round Trip of Work Train.



Estimated Cost of Digging Ditches by Various Methods up to 15 Miles Haul.

*Extracts from a committee report to the St. Louis meeting of the Roadmasters' and Maintenance-of-Way Association.

10 and 16 men actually ditching under the protection of two flagmen. It is here assumed that 20 per cent. of the time is lost on account of the traffic, but that this 20 per cent. covers the time spent in trimming up the cut. On the diagram the three dotted lines indicate cost per yard if the men shovel the material off the car, while the three full lines indicate the cost if the car is so arranged that the material can be dumped, by placing an entirely separate box, open at one side, on the bed of the car, or some other suitable method. By such an arrangement, the cost per yard can be reduced some 3 to 4½ cents over shoveling the material off the cars.

By Work Trains and Hand Loading.—The diagram is plainly marked showing the method covered by each line, and it is only necessary to call attention to the fact that where only 60 cu. yds. are handled per trip, the lines are dotted lines, and full lines are used where 120 cu. yds. are handled per trip. In all cases with work train except one it is assumed that all the men employed go with the train to unload, and for this reason the cost with 50 men, handling 120 yds. per train, becomes less than with 100 men under the same conditions, after a haul of about 2,600 ft. or one-half mile has been reached. If, however, the work is properly handled the whole number of men employed (where such large numbers are used) are not sent with the train, but are kept at work at the ends of the cut ditching with wheelbarrows, or possibly casting the material, where such can be done by the use of a platform, while part of the men unload, and the cost will be reduced considerably, it being possible, by a proper arrangement, to reduce the cost to almost what machine ditchers will accomplish.

A portable platform for carrying on the work trains for use in cases where material can be thrown out of the cuts by two castings, is described in Camp's "Notes on Track." This is a device consisting of two 2-in. by 6-in. posts 12 ft. long, with two 2-in. by 6-in. horizontal pieces 10 ft. long running into the bank to support the platform of five 1-in. by 12-in. boards 5 ft. long. The posts and horizontal supports are bored at intervals to permit adjustment of the height of platform. In a deep cut, a second scaffold may be placed above the first. This device was first furnished section foremen on the Southern Railway by Mr. W. A. Fort, Supervisor, but was found to be of such value as a time saver when trains were late, that ditching trains were equipped with them. One man on the scaffold can handle about as much dirt as two men can handle in the ditch.

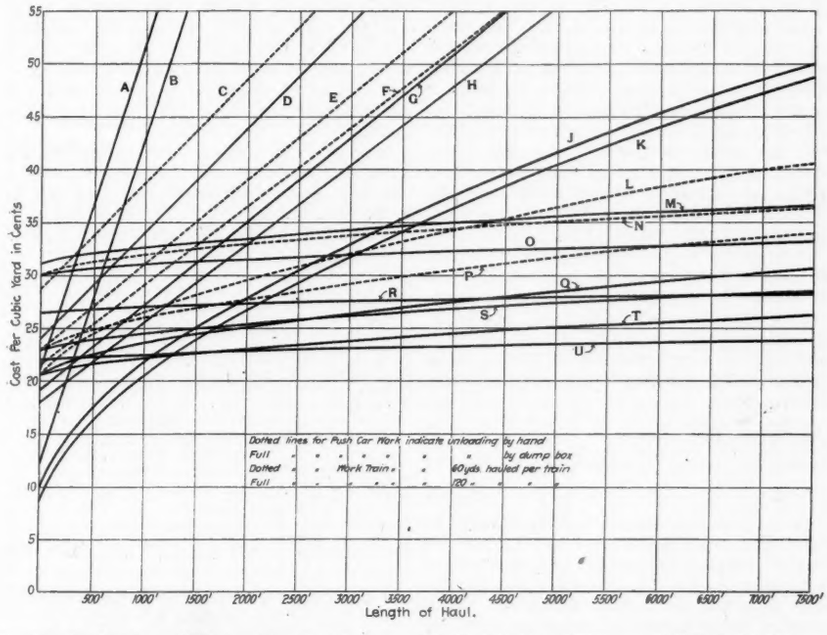
On this diagram the question of using two or more work trains with a gang of say 100 men loading, the unloading being done at a distant point by plow and cable, has not been considered, as work of such character would vary to such an extent with the local conditions, that it would necessarily have to be considered for each individual case; it may be mentioned, however, that 100 men could load 1,000 cu. yds. of material already loosened and placed conveniently for loading, in four hours actual working time, and at that rate the total cost for one train amounting to say $22 per day, would be but 2.2c. per cu. yd. In order, therefore, to keep such a gang busy, a sufficient number of trains should be used, if conditions, such as traffic, side track facilities, etc., will permit. The whole question with work trains, therefore, resolves itself into equalizing the number and disposition of men employed, with the train service in such a way that one will not over-balance the other, and both will be in accordance with the requirements in regard to length of haul, traffic conditions, etc.

Machine Ditchers.—Machine ditchers may be divided into two general classes: (1) Ditchers which load a scoop on one or both sides and then run to the end of the cut to dump the material, and (2) those which load a full train of material and unload by plow or by hand. The first kind can be used to advantage only where the haul is comparatively short, while the second class is economical for a long haul. The designing of a machine ditcher, or the selecting of one already built, in order to obtain the best results, requires careful study and consideration.

The requirements of a suitable machine ditcher are that it shall be able to cut the full depth necessary and close up to the ends of the ties in order to obtain a standard section; that it shall be quickly handled with the least number of men practicable; that it shall have the fewest possible parts likely to get out of order, and that it shall be capable of sloping the banks in fair shape either by a slope board or dipper under control of the engineer, the slope board probably being desirable even with the dipper. The dipper or scoop should be as large as can be handled to advantage in order to reduce the cost per yard. As in the case of steam shovel work, the engineer or the man in charge of handling the scoop or dipper, should be thoroughly competent, as the cost per yard of material will be greatly increased if the shovel work is handled slow.

In ditching with a Mahoney ditcher on the B. & O. S. W. during May and June, 1904, it was found that from 12 to 16 cu. yds. could be loaded every 30 minutes in wet or soft soil. The machine is probably not well suited for very hard digging, as the dipper is hinged to the beam, and the weight of the dipper is the only power it has to force itself into the soil. It would require about 30 seconds to move the ditcher ahead and required moving the machine three times for each car load. The crew used to operate this machine was one engine and crew, train crew and four men to operate the ditcher. This machine would not be suitable for ditching in rock cuts, where the ditch is not always the same distance from the track. The material excavated in this particular case was very wet and would have been exceedingly expensive to handle by hand. The record of cost of this work is given in the appendix.

The report is signed by T. S. Forquharson, W. J. McDermont, V. K. Hendricks, C. E. Elliott, J. Murphy.



A—By wheelbarrow—digging wet and bad.
B—By wheelbarrow—digging dry and easy.
C—By push-car, shoveling off dirt, 2 flagmen and 4 ditching, 20 per cent. lost time.
D—By push-car with dump-box, 2 flagmen and 4 ditching, 20 per cent. lost time.
E—By push-car, shoveling off dirt, 2 flagmen and 10 ditching, 20 per cent. lost time.
F—By push-car, shoveling off dirt, 2 flagmen and 16 ditching, 20 per cent. lost time.
G—By push-car, with dump-box, 2 flagmen and 10 ditching, 20 per cent. lost time.
H—By push-car with dump-box, 2 flagmen and 16 ditching, 20 per cent. lost time.
J—Machine ditcher, 5 yd., bad material.
K—Machine ditcher, 5 yd., 40 per cent. lost time.
L—Work train and 50 men, 60 yd. per trip, 40 per cent. lost time; all men to unload.
M—Work train and 100 men, bad material, 50 men to unload; 120 yd. per trip.
N—Work train and 20 men, 60 yd. per trip, 40 per cent. lost time; all men to unload.
O—Work train and 20 men, 120 yd. per trip, 40 per cent. lost time; all men to unload.
P—Work train and 50 men, 60 yd. per trip, 40 per cent. lost time; all men to unload.
Q—Work train and 100 men, 120 yd. per trip, 40 per cent. lost time; all men to unload.
R—Machine ditcher, 120 yd. per trip, bad wet material.
S—Work train and 50 men, 120 yd. per trip, 40 per cent. lost time; all men to unload.
T—Work train and 100 men, 120 yd. per trip, 40 per cent. lost time; 50 men to ditch with barrows.
U—Machine ditcher, 120 yd. per trip, 40 per cent. lost time; unloading with plow and cable.

Cost of Ditching by Various Methods up to 7,500 Feet Haul.

APPENDIX.

For the purpose of determining the actual cost of hauling by train, a diagram is made a part of this appendix, showing the number of minutes actual running time estimated to be consumed for the round trip for the various lengths of haul. By determining the cost per minute of the train and crew, and any other men who go with the train, the cost per yard for actual hauling can be determined from this diagram. It is assumed that this time diagram will apply to any train, whether it carries but 5 cu. yds. per trip or 120 cu. yds. per trip, although the short trains can, of course, be handled more quickly than the heavier ones.

The details of the estimated cost per cubic

yard for handling work by the various methods considered is as follows:

By Wheelbarrows.

For common loam, the cost is taken at:

Loosening and loading on barrows	9.8 cts.
Leveling earth on embankments	.7 "
Repairs to tools	.2 "
Superintendence and water carriers	1.5 "
Total	12.2 cts.

To this fixed charge, a constant per 1,000 ft. haul is to be added as follows:

	Per 1,000 ft.
Repairs to gangways	1.0 cts.
Wheeling material	30.0 "
Total	31.0 cts.

In handling bad, wet material, it is assumed that the fixed charge will be increased 60 per cent., or 7.3c. per cu. yd., while the cost of wheeling remains the same.

By Push Cars.

If material is unloaded by shovel, the cost, exclusive of flagmen, is taken as follows:

Loosening and loading on push cars	9.8 cts.
Leveling earth on embankments	.7 "
Repairs to tools	.2 "
Superintendence and water carriers	1.5 "
Unloading push car	3.7 "
	15.9 cts.
20% lost time	3.2 "
Total cost, per yard.	19.1 cts.

To this fixed charge a constant is to be added to cover the cost of hauling, amounting to 33.4c. per cu. yd. per 5,000 ft. haul. As this amount covers the actual cost without including flagmen, the cost per yard will be increased by one-half the total amount given above, if two men out of the gang of six are kept flagging while four men do the ditching. In case ten men do ditching while two men flag, the increase over the above figures will be one-fifth of these figures; and if 16 men ditch and two flag, the increase will be one-eighth over above cost.

If a dumping box, or some similar arrangement, is used on the bed of the push cars to unload quickly, the cost, exclusive of flagmen, is estimated as follows:

Loosening and loading on push cars	9.8 cts.
Leveling earth on embankments	1.5 "
Repairs to tools	.2 "
Superintendence and water carriers	1.5 "
Unloading dump box	.3 "
	13.3 cts.
20% lost time	2.6 "
Total	15.9 cts.

To this fixed charge should be added a constant amounting to 33.4c. per yard for 5,000 ft. haul to cover the cost of time consumed hauling. If two men are kept flagging, while either 4, 10 or 16 men are ditching, the portion of the above cost to be added is as given in the case of push cars unloaded by shovel.

By Work Train and Hand Labor.

The cost for train and crew, coal, etc., is taken at $22 per day for work train, and the actual working time is taken at six hours per day, allowing for 40 per cent. of the working hours to be lost time.

With 20 men on train, the cost for handling common earth is estimated as follows:

Loading (40% lost time used in loosening, trimming, etc.)	11.2 cts.
Unloading	3.8 "
Repairs to tools	.2 "
Superintendence and water carriers	1.5 "
Cost of train loading	7.3 "
Cost of train unloading	4.6 "
Total	30.1 cts.

To this fixed amount, the cost of train and crew, together with laborers during the time traveling to and from the place of unloading, is taken from the diagram showing time consumed in round trip of work train, the variable, of course, being twice as much per cubic yard if 60 yds. are hauled per train per trip, as it is in case 120 yds. are hauled per trip.

With 50 men on train, the estimate is as follows:

Loading (40% lost time used in loosening, trimming, etc.)	11.2 cts.
Unloading	3.8 "
Leveling embankments	1.5 "
Repairs to tools	.2 "
Superintendence and water carriers	1.5 "
Cost of train loading	2.9 "
Cost of train unloading	1.8 "
Total	22.9 cts.

The variable to be added to cover the time of train crew and men traveling to and from the place of unloading is taken from the diagram, as in the case of 20 men with the train.

With 100 men on the train, the cost is estimated as follows:

Loading (40 per cent. lost time used in loosening, trimming, etc.)	11.2 cts.
Unloading	3.8 "
Leveling embankments	1.5 "
Repairs to tools	.2 "
Superintendence and water carriers	1.5 "
Cost of train loading	1.5 "
Cost of train unloading	.9 "
Total	20.6 cts.

The variable to be added to cover time consumed in running to and from place of unloading is obtained in the same manner as in the case of 20 men with work train.

By Machine Ditcher Hauling 5 yds. Per Trip.

It is assumed that all expenses connected with the train, including crew, fuel, etc., amount to $22 per day, and that there is an additional expense of $6 per day on account of labor handling scoops, making the total cost $28 per day, and that but six hours actual time is worked per day, which makes the cost per minute 7.78c., or 1.6c. per yard per minute with 5 yds. hauled per train.

It is assumed that 5 yds. can be loaded in 2½ minutes in fair digging, exclusive of running time to dump, making the cost 4 cents per yard. The estimated total cost is, therefore:

Loading and dumping	4.0 cts.
Leveling embankments	1.5 "
Superintendence and water carriers	1.0 "
Interest, depreciation and repairs	2.0 "
Total	8.5 cts.

To this fixed charge, a variable amount is added to cover the lost time running to and from the place of unloading, which variable is taken from the diagram showing running time consumed in making round trip. The interest, depreciation and repairs is based on the supposition that the loading device, spreader, etc., costs $1,000 and loads 10,000 cu. yds. per year, the interest and repairs each being taken at 5 per cent. per annum and depreciation at 10 per cent. per annum

If the ditching is being done in bad, wet material, the cost of loading and dumping is supposed to be increased 30 per cent., which would make a uniform increase in the cost per yard of all lengths hauled of 2 cents per yard over the cost in fair digging.

As a confirmation of the estimated cost by this method, reference is made to the paper by R. S. Stanley, Roadmaster of the C. R. I. & P. R. R., presented to this Association at its meeting in Kansas City, October, 1903, in which he states on page 89 of the Proceedings that earth can be handled at an expense of from 8c. to 28c. per yard, using a Mart ditching machine, and on page 90, from 6c. to 15c. per yard with a 500-ft. to 800-ft. haul by the American Steel Foundry Company's machine.

Machine Ditcher Loading a Full Train.

A somewhat greater shovel crew is required for a machine ditcher of this class than of the class mentioned above, and it is assumed that the shovel crew wages amount to $10 per day, making a total of $32 for train and crew, which, if actually working only six hours per day, would be $5.32 per hour, or 9 cents per minute. It is assumed also that a train hauling 60 yds. can be unloaded in 15 minutes with plow and cable, making the unloading cost practically 2.2c. per yard, and that a train hauling 120 yds. can be unloaded in 20 minutes, at a cost of about 1.5c. per yard. It is further assumed that it requires 1⅔ minutes to load 1 cu. yd. in fair digging, which would make the cost per yard 15 cents for loading. The estimated cost, therefore, with 120 yds. loaded per train, is as follows:

Loading cars	15.0 cts.
Unloading cars	1.5 "
Switching	1.0 "
Leveling embankment	1.5 "
Superintendence and water carriers	1.0 "
Interest, depreciation and repairs	2.0 "
Total	22.0 cts.

The cost for interest, depreciation and repairs is based on an original cost of $2,000 for the machine ditcher, and the supposition that 20,000 yds. per year will be handled. In case only 60 yds. is handled per train instead of 120 yds., the cost of unloading will be 2.2c. instead of 1.5c., all other items being the same, which would make a total cost per yard of 22.7c. In case the material excavated is wet and very hard to handle, it is assumed that the cost of actual loading will be increased 30 per cent. over the above figures, equaling 4.5c. per yard additional.

In confirmation of the above estimates, the following statement of the actual cost of ditching on the Illinois Division of the B. & O. S-W. R. R. with a Mahoney ditching machine during last May and June is given:

May 11 to May 28, 1904.

Total number of days worked	10
Total number of yards loaded and unloaded	1,245
8 days haul was 7 miles and 2 days haul was 2 miles, making an average of 6 miles.	
Total cost of loading, including work train	$241.67
Total cost, unloading, including work train	55.66
Cost per cu. yd. loading	19.4 cts.
Cost per cu. yd. unloading,	4.5 "
Total cost per cu. yd.	23.9 "
Total delays in 10 days	32 hr. 10 min.

June 1 to June 23, 1904.

Total number of days worked	10.5
Total number of yards loaded and unloaded	1,245
Average haul, miles	1.75
Total cost of loading,	$274.88
Total cost of unloading	857.64
Cost per cubic yard loading	22.0 cts.
Cost per cubic yard unloading	4.6 "
Total cost per cubic yard	26.6 "
Total delays during 10.5 days	23 hrs. 10 mins.

Comments on the Per Diem Rules.

BY ARTHUR HALE.

(*Concluded from page 431.*)

10.—"The junction report for each day shall be made to car owners on the prescribed form (D) as promptly as possible after the receipt of the interchange report for that day."

The junction report enjoined by this rule is the original junction report adopted by the Car Accountants' Association so many years ago. This was the first car service agreement between American railroads and is practically the only railroad agreement that we have never changed, as it was only confirmed by the adoption of the present per diem rules. The car service rules of the American Railway Association are comparatively juvenile when compared to the junction card arrangement and were never so generally effective.

11.—"Within thirty days after the end of each calendar month, car owners shall be furnished with a per diem report for that month, on the prescribed form, showing the number of days each car has been in service upon the road making the report."

Under this rule the per diem report for each month is absolutely independent of any past performance, and the number of days a car is used by the road in question is reported at the expiration of that month. This rule was based on the experience of 1888. Under the first set of rules the junc-

tion card was made the vehicle for settling per diem and the amount due was not reported until the car had left the line. This resulted in such delay to junction reports that it was speedily given up and attempts to revive it in 1902 were successfully resisted. One argument in favor of closing the reports at the end of each month, was that if the per diem report on each car were held until the car was delivered, there would never be any per diem paid on cars held permanently.

12.—"The settling of amounts accruing for the use of cars and reclaims under rule 5, shall be made monthly without regard to reclaims pending under rules 13, 14 and 15."

This rule, as originally passed, provided for the prompt settling of the regular per diem, even if there were a question as to reclaims, but it has now been amended so that switching reclaims are also settled promptly without regard to other reclaims. It might be noted that the word "reclaim," which was hit upon in the formulation of Rule 5, is intended to cover practically all adjustments of per diem necessitated by special agreements and unforeseen circumstances. This word coinage has been singularly successful and "reclaim," seems to be fully established in American railroad language.

The same may be said of the terms "per diem" and "penalty." It is rather curious that these three definitions which have met with such general acquiescence, were made in the body of the rules and not in the series of definitions. Sundry attempts were made to incorporate these terms in the definitions, but it was found to be easier, if not clearer, to incorporate these definitions in the rules, as was finally done. Care was taken, however, not to incorporate rules in the definitions.

13.—"When reclaims are made for allowances, under rules 13, 14 and 15, or on account of special conditions, they must be made by the designated transportation officer of the road from which the allowance is reclaimed."

This rule was introduced from a fear that the traffic departments would attempt to interfere with the per diem system. The rule has probably done no harm, but, it is duobtful whether it is necessary, as the traffic departments of the railroads have in general left per diem severely alone. The only case on record of general interference by the traffic department was occasioned by the refusal of a certain private car line, owned largely by railroads, to place its cars under per diem. It was feared by some of the traffic departments that this arrangement would give this line an advantage in enabling it to hold refrigerators on certain railroads where refrigerator traffic originates. To meet this supposed cut in the rates, the traffic departments of a number of railroads secured an arrangement under which the competing refrigerator cars of these roads should be held freely for this traffic. If it were found that under the old mileage rate the payments on such originating roads would be less than under the per diem rates, reclaim for the difference in the amounts was to be entertained by the car owners.

It appears that practically no refrigerators are unduly held for traffic, and there are few instances where these reclaims are made. In point of fact, the private line in question held on to the mileage rate for revenue only, and the suspicion of rate cutting was wholly unwarranted.

14.—"A road failing to receive promptly from a connection, cars upon which it has laid no embargo, shall be responsible to the connection for the per diem on cars held for delivery, including the home cars of such connection.

"If such a failure to receive shall continue for more than three days, the delinquent line shall thereafter be responsible in addition for the per diem on all cars wherever in transit, which are thus held back for delivery.

"It shall be the duty of a connection intending to reclaim such per diem allowance, to notify the delinquent line daily of the total number of cars so held for it, and, when required, to furnish the initials and numbers of the cars."

15.—"When a road gives notice to a connection that for any reason it cannot accept cars in any specified traffic, thereby instituting an embargo, it should receive cars already loaded with such traffic at the time such notice is issued. If it does not receive such cars, the road holding them may reclaim per diem from the road placing the embargo for the number of days such cars are held, not exceeding the duration of the embargo. After the date of such notice, a road must not load or reconsign cars in such traffic to the road issuing the notice. All such notices must be given by telegraph by the embargoing road, to its immediate connection and by it transmitted as may be necessary."

These are new rules, which, like the other new rules, have made some trouble, but they have stood so far without amendment, although at certain switching centers they have been modified.

The idea of the rule is, of course, to keep a pressure on the road which is to dispose of the lading and through this road to keep a pressure on the consignee, so as to compel an embargo or improved facilities. At certain large switching centers it has been found better to let the trunk line hold back cars which cannot be delivered to congested industries, charging the regular car service, and where this has been practicable, agreements have been made by which Rules 14 and 15 do not apply.

The rules were very difficult to formulate and the credit for them as they stand is due to the late Mr. Drew, who was at that time Superintendent of Car Service of the Chicago, Rock Island & Pacific, more largely than to any one else. An attempt was being made to cover, under one rule, cars held under embargo, and cars held without embargo, and Mr. Drew called attention to the fact that the situation would be much simplified if two rules were made, one which would put a penalty on the refusal to accept cars on which an embargo had not been placed, and second, relieving of all responsibility a railroad which had laid a proper embargo. The result of this suggestion was the formulation of the two present rules. They are the first attempt to regulate generally the embargo as between railroads. The embargo has now been recognized as a necessity, which justifies its advocacy, as a necessary transportation expedient, by the late William P. Shinn many years ago.

Without the recognition and definition of the embargo, it is hard to see how any per diem system could be made a permanent success, and with the recognition of the embargo system, it would seem that there should be some penalty among railroads which neglect to place embargoes against freight which they cannot handle.

16.—"These rules shall not apply to private cars."

When the per diem rules were adopted, dissatisfaction was expressed in certain quarters that they made no provision for private cars. Since that time the private car question has been energetically investigated by a master hand, and it is safe to say that the dissatisfaction with the per diem rules in this respect has diminished.

The private car question is not one question, but means different things to different people. In some parts of the country it is the refrigerator question; in other parts the stock car question; in other parts the coal and coke car question, and so on. Is anyone bold enough to propose one solution for all these private car questions?

Again, no one claims that railroads when dealing with parties not railroads should agree with each other as to the prices they should pay. We find no one designating a uniform rate to be paid private parties for the lease or purchase of steel rails, locomotives, or real estate. There is a consensus of opinion that, as between railroads, a uniform rate should be in effect, and that a per diem rate; but exactly why all railroads should pay private parties and corporations the same price for box, stock, refrigerator and gondola cars is not evident. Very possibly too much is now paid for certain cars, but that does not prove that the present per diem rate ought to be extended to all private equipment.

This rule has, however, had one unfortunate result. A prominent railroad has transferred all its refrigerator cars to a so-called private car company and is charging a mileage rate for them. This has caused a good deal of dissatisfaction and has elicited threats of similar action by other railroads; but when it has been seriously proposed to meet this action by increasing the per diem on refrigerator cars to a paying basis, say 40 cents a day, there has been no general acquiescence among the railroads, although it has been hoped that if such an arrangement were adopted, it might result in putting all refrigerator cars, railroad and private, on one basis.

There is one practical difficulty in the way of paying per diem on private cars. In case such cars are not needed for business, the railroad on which they are held will object to paying per diem for them; and most of the owners of private cars have no tracks sufficient to hold them when they are not in use.

17.—"To interpret these rules and to settle disputes arising under them, an Arbitration Committee of five members shall be appointed by the Committee on Car Service. Three members of the Arbitration Committee shall be a quorum.

"In case any question or dispute arises under these rules, it may be submitted to the Arbitration Committee through the secretary of the association in abstract. The abstracts shall briefly set forth the points at issue and each party's interpretation of the rules upon which the claim is based. The Arbitration Committee shall base its decision upon the rules and the abstract submitted, and its decision shall be final. Should one of the parties refuse to furnish the necessary information, the Arbitration Committee shall use its judgment as to whether or not it can properly decide. All decisions shall be reported to the Association through the Committee on Car Service.

"In case a question shall arise not covered by the rules, the roads disagreeing may by mutual consent submit such questions to the Arbitration Committee.

"The Committee on Car Service may appoint a secretary for the Arbitration Committee, who shall be paid by the Association. The other expenses of the Arbitration Committee shall be divided equally between each of the parties to the dispute and the Association. The minimum charge to each road shall be ten dollars, payable in advance. The expenses shall first be paid by the Association and then billed to the parties concerned by the treasurer of the Association."

This rule, covering the arbitration of disputes, was modeled after the arbitration rule of the Master Car Builders' Association. The Arbitration Committee, at its first meeting, fully intended to follow the Master Car Builders in their practice, under which decisions are only made on actual cases, and no hypothetical cases are entertained. The committee, however, received such a flood of questions of general interest from so many railroads that it felt obliged to answer a number of cases which strictly were hypothetical. In answering these questions, the committee called them "Interpretations," and the interpretations are printed in the rules. A jurist

would consider such a course very dangerous, but in point of fact these interpretations have saved much more trouble than they have caused.

Definitions.

These definitions were adopted as much for the elucidation of the car service rules as the per diem rules. Indeed, it was in the mind of the committee that under the per diem system it would speedily become necessary to adopt a rule covering penalty for the diversion of cars, and when the time comes, these definitions, which have been generally accepted, will be of great use.

As indicated in the comments under Rule 6, there is a general movement on foot to continue per diem and penalty when a car is diverted by a connection to a non-per diem road, but further than this, the movement toward penalty for diversion has made no progress. There are great technical difficulties in the way of the formulation of a rule prescribing a penalty for diversion, but like all technical difficulties, these can doubtless be overcome as soon as the absolute need of a penalty for the diversion of cars becomes evident. It was anticipated that under the per diem system diversions would increase, but this does not seem to be the case. Certainly there are not so many "old cases" of cars away from home two or three years as there used to be. This seems to be because the per diem and penalty rules keep foreign cars moving, and even if they move wrong, they get home after a dozen or two of trials.

Per Diem Rules Agreement.

The only difficulty with the per diem rules agreement is, as noted under Rule 3, that it was signed by a number of corporations which are not really railroads at all. They may be called "industrial roads," but from a car service standpoint, they are sidings just as clearly as is any 100 ft. stretch of track.

When the per diem rules were formulated, amid the declared opposition of all the belt lines and a very respectable number of long systems west and south, it never occurred to the framers of the rules that any railroad would want to sign it that should be kept out. But a number of private-siding corporations have signed the agreement and it is to be hoped that the American Railway Association will so define the term "railroad company," as to exclude railroads which are not railroads at all.

The reason per diem has come to stay and that there has been no serious effort to overthrow it, is that it has brought about an improved movement of foreign cars on most of our railroads and an improved movement of home cars on some railroads. In other words, it has secured a sensible increase in the work done by the freight cars of the railroad companies. This is not done in a mysterious way, but simply by making it profitable for railroads to educate their men in car handling, to utilize all their engines in handling cars and to buy or build more engines so as to handle cars more promptly. Just what this increase in the number of miles per day made by freight cars has been, cannot as yet be said, but it is certainly enough to justify and preserve the per diem system.

The Locomotive Boiler Water Changing Plant of the Pittsburg & Lake Erie.*

This plant has been in successful operation since November, 1903, and by it the foul water is removed from locomotive boilers; the heat is saved, and used in heating the water for refilling, and the boiler is refilled with water having a temperature of about 300 deg. F.; the whole operation requiring from 20 to 35 minutes, depending on the size of the boiler. If the condition of the boiler at the commencement of the operation showed steam pressure of 100 to 125 lbs. per sq. in., and if the fire were banked, which is desirable, the steam pressure during the process will not have fallen below about 75 lbs. per sq. in. This water change is made without allowing any steam to escape into the atmosphere, and also without discharging any water on to the floor of the roundhouse or into the pits. While this work is being done the temperature changes in the boiler are very slight, being not more than 30 deg.; from 350 deg. F. to 320 deg. F.

On many roads there exist conditions which make it desirable to change the water much oftener than it is necessary to remove the plugs to wash out mud or scale. The list of these roads includes those that use water having alkaline and other soluble compounds that are not precipitated in the form of scale in the boilers; others that use waters that make a small quantity of scale that does not cement or adhere to the metal; and lastly the rapidly increasing number that have awakened to the importance and economy of purifying the water, by removing all scale-forming solids, and mud in suspension, before the water is delivered to the locomotive boilers. In all these cases there is a concentration of the soluble compounds in the boiler as the evaporation continues, which results in foaming, priming, etc. The necessity for changing the water may vary from once after each trip each way over a division, where bad alkaline waters are used, to once each round trip, or once in each two, five, 10 or 15 days, depending on the condition of the water used and the amount evaporated.

The condition of the water on the P. & L. E., where treated water is used, is such that it is necessary to remove the plugs for washing only once in from 20 to 45 days. During this time the water is changed whenever necessary, or on an average of about once each five days. The benefits resulting from the use of treated water, in comparison with the conditions existing when the locomotive feed water was used in the raw condition as pumped from the rivers are clearly shown by a few facts taken from the records. Comparing results in August, 1902, with those of August, 1904, raw water having been used during the former and treated water during the latter period:

a. Number of trains given up on the road on account of leaking boilers during August, 1902, 27; number given up for the same cause in August, 1904, two.

b. Number of trains that had to reduce the loading by setting off cars on account of boilers leaking during August, 1902, 13; August, 1904, none.

c. Number of through trains, during August, 1902, with delays of one hour or more, that had locomotives changed at McKees Rocks, on account of boilers leaking, 31; for August, 1904, three.

Other results attained show enormous advantages in favor of using purified water, in the increased life of flues and of fireboxes, etc., and in the reduction of boilermakers' wages, in the increased service obtained from the locomotives and the reduction of fuel necessary on account of the removal of scale.

In using the plant herein described locomotives requiring a change of water have their fires cleaned in the usual way and are sent to the roundhouse preferably with

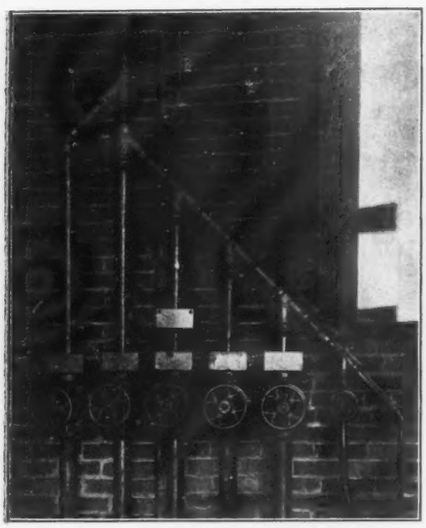


Fig. 1—Manifold and Connections.

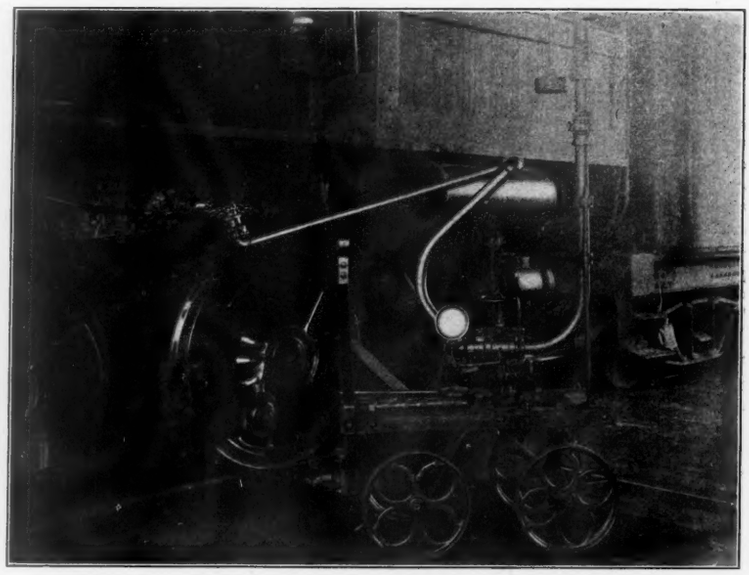


Fig. 2—Flexible-Pipe Truck in Use.

*A paper presented to the October meeting of the Western Railway Club by A. R. Raymer, Assistant Chief Engineer of the Pittsburg & Lake Erie.

fires banked and steam pressure at about 100 to 125 lbs. Blow-off cocks have been placed in the left side of the fire-box near the bottom. An overhead 2½-in. blow-off pipe is located between engine pits, with a pipe coupling about 6½ ft. above the floor opposite the blow-off cock in boiler. The other end of the blow-off pipe connects with a manifold on the wall of roundhouse, shown in Fig. 1. A flexible pipe with necessary joints, gage, drip cock, and extension pipes for reaching blow-off cocks, when located in front of boilers, is mounted on a light truck for convenience of operation (Fig. 2.) This flexible-pipe truck is placed in position opposite the blow-off cock, and connected therewith, and also with the blow-off pipe overhead, after which the valves are opened and the water in the boiler is forced out by the steam pressure in 10 to 20 minutes. When all of the water is blown from the boiler the blow-off valve in the manifold is closed and the "superheated" water (at a temperature of 300 deg. F. and with a pressure of 125 lbs.) is admitted by opening a valve in the same manifold and the boiler is quickly refilled with pure water forced into the boiler through the blow-off cock, after which the valves are closed and the flexible pipe disconnected and removed. There remains in the boiler a steam pressure of about 75 lbs. after foul water is fully removed and the pure water is forced in against this pressure.

The manifolds are placed on the roundhouse wall, one for each of as many pits as it may be desired to serve; pipe mains are laid under the floor in an accessible trench, one for each branch of the manifold. It has been found desirable to have the manifolds include the following service pipes: Live steam (at about 150 lbs. pressure); blow-off pipe; superheated water; hot water (at a temperature of about 200 deg. F.—the hot well temperature—and a pressure of about 125 lbs.); cold water (at supply temperature, say about 50 deg. F., and at about 90 lbs. pressure); test water (at supply temperature and at any desired pressure up to 300 lbs. per sq. in.).

The live steam is used for heating up empty, cold boilers. This can be safely done in about 10 minutes' time, in which time the temperature is changed from cold conditions up to about 300 deg. F. The action of the steam on the empty boiler shell is uniform throughout its mass; it consequently causes no unequal expansion, and therefore no bad results. Live steam is also used for increasing the temperature and pressure in a boiler full of water and under low steam pressure.

The blow-off pipe from the manifold is used to convey blown-off water and steam to the blow-off tank, described later.

Superheated water is used for refilling boilers when water is changed for filling empty boilers after they have been warmed up by use of live steam.

Hot water is used for filling boilers "whistle full" when a hydrostatic test is to be applied by "test water" at proper pressure. Hot water is also used to cool down boiler shells quickly and safely. Say a boiler has 100 lbs. steam and it is desired to have it empty and cool as quickly as possible. The water is blown out of the boiler and the steam is allowed to follow until the pressure is not more than 10 to 15 lbs. (The temperature of the metal will still be up to about 300 deg.) The valves are then changed and hot water is forced in, which cools the shell gradually, after which cold water may be mixed with the hot water for further cooling.

Cold water is used for removing mud, scale, etc., when necessary, by the old method of washing.

Test water is used as described above for producing hydrostatic pressure in the boiler. It is furnished by a pump set to the pressure wanted, which pressure can be held as long as may be desired. As this test pressure is on the manifold, it and the flexible piping up to the blow-off cock are tested each time test pressure is used.

Fig. 3 is a diagrammatic view of the plant. The blow-off pipe, B, attached to blow-off cock A conveys water and steam from boilers to blow-off tank, T, which tank is closed and furnished with a pipe, E, to convey steam to condenser, F, and if in excess, to the atmosphere. There will, therefore, be atmospheric pressure in the blow-off tank, T; consequently the superheated water and steam blown from the boilers will immediately on arrival at the blow-off tank drop to a temperature of 212 deg. and all heat above that amount will pass in steam through pipe E to the condenser.

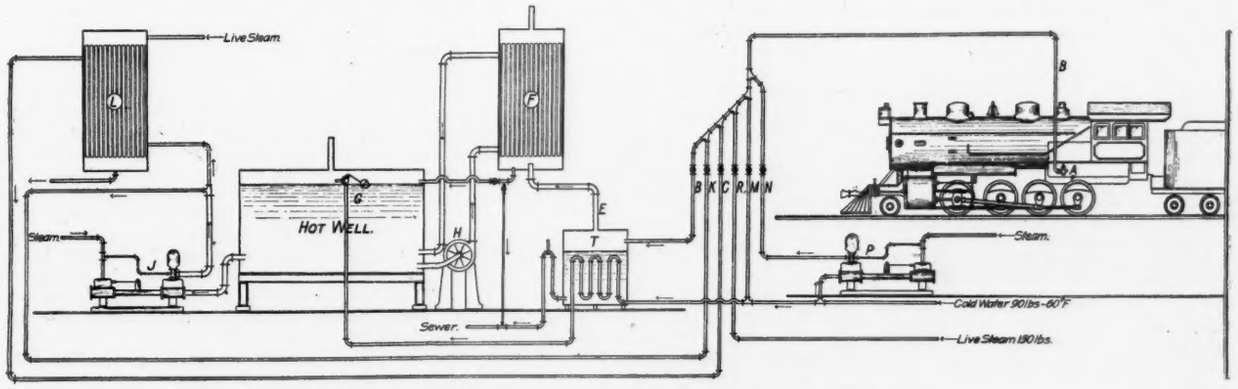


Fig. 3—Diagram of Connections for Boiler Water Changing Plant.

A hot well is located near, and below, the condenser. It is kept full of pure water from the supply by means of a float valve, G. This supply water for the hot well flows through a coil in the blow-off tank, thereby extracting considerable heat from the foul water left therein, reducing its temperature below 212 deg. A centrifugal pump, H, draws water from the hot well, and circulates it through the condenser, F, and back to the hot well, thereby condensing the steam and transferring the heat to the water in the hot well. The water of condensation also flows from the condenser to the hot well, or to the sewer as may be desired.

A hot water pump, J, is located below the hot well level and draws water from it and forces it by pipe K to the hot water valve in the manifold, and by pipe C through a live steam heater, L, to the "superheated" valve in manifold. This pump is set for a constant pressure of 125 lbs. and is controlled by a steam pressure regulator. The test pump, P, is of the usual steam pressure regulated type easily adjusted for the pressures wanted, up to 300 lbs. per sq. in.

Few persons who have not made this work a special study will appreciate the amount of heat lost when an ordinary locomotive boiler is blown off and no attempt made to save it. An ordinary freight locomotive boiler will hold about 2,500 gals. of water when in working condition. This amount of water when at steam pressure of 100 lbs. has in it an amount of available heat *above* 212 deg. F. equal to 2,600,000 B. T. U. and nearly an equal amount in the metal of the boiler shell and connected parts. The amount of heat blown off from a boiler of this kind at 100 lbs. pressure will evaporate about 2,700 lbs. of water at 212 deg. F., and this amount of heat along with that saved from the foul water is sufficient to raise the refilling water from an initial temperature of say 60 deg. F. up to 200 deg. F. In delivering this refilling water to the boiler at say 300 deg. F. the additional heat above that of the hot well, which is at about 200 deg., is furnished by live steam from stationary boilers. No one will question the economy of drawing heat from a modern power house with stokers and high efficiency boilers, rather than trying to heat up locomotive boilers in the old way by smoky fires, with expensive draft obtained by the use of compressed air or steam.

Some of the different kinds of service rendered by this plant, taken from actual practice, are shown in the following:

Locomotive No. 302, P. & L. E. Atlantic type passenger, with 115 lbs. steam and no fire, was emptied, and 18 minutes' work done on the empty boiler; afterwards boiler was filled, fired up and engine left roundhouse, all in 80 minutes, following being the log:

8.55 p.m. commenced blowing off. The boiler pressure was 115 lbs.; no fire.

9.18 p.m. water all out; pressure 80 lbs.

9.21 p.m. steam all out; pressure 0.

Work was done on boiler from 9.21 to 9.39.

9.39 p.m. commenced filling with superheated water.

9.48 p.m. boiler showed 1½ gages water; pressure 50 lbs.

9.46 p.m. fire started.

9.48 p.m. commenced delivering live steam into boiler.

10.01 p.m. shut off live steam; boiler pressure then was 85 lbs.

10.15 p.m. locomotive left roundhouse with 140 lbs. steam.

Water Change.—Heavy freight locomotive, P. & L. E. No. 174. Fire was banked with steam pressure at 112 lbs., water change

was made in 37 minutes, and steam pressure did not fall below 50 lbs.

4 p.m. commenced to blow off water; boiler pressure 112 lbs.

4.24 p.m. water all out; boiler pressure 90 lbs.; continued blowing steam.

4.26 p.m. stopped blowing; boiler pressure 50 lbs.

4.27 p.m. commenced filling with superheated water.

4.37 p.m. boiler showed two gages, and pressure of 75 lbs.

At 4.40 locomotive left roundhouse.

Passenger engine No. 95, 4-4-0 type, was emptied for boiler work at 3.11 p.m.; work was finished at 4.45 p.m. Boiler was still warm but empty and under no pressure. Live steam was turned into it at 4.45 p.m. for six minutes, in which time pressure rose to 70 lbs. At 4.52 p.m. superheated water was started and in six minutes boiler had 2½ gages; pressure was now 58 lbs. Fire was started at 4.58 and live steam was again turned on at 4.59 into boiler full of water at 58 lbs., and at 5.04 the pressure was 100 lbs. The locomotive left roundhouse at 5.05 p.m.

Locomotive No. 792 (L. S. & M. S.) from shop:

9.33 a.m. cold and empty, live steam started.

9.43 a.m. boiler pressure was 55 lbs. with no water, excepting water of condensation in it.

9.44 a.m. superheated water was started.

9.56 a.m. boiler showed two gages water.

9.56 a.m. fire was started.

9.57 a.m. live steam again turned on.

10.05 a.m. boiler showed 90 lbs. steam, and engine left roundhouse.

Locomotive No. 89—No fire; steam pressure was 120 lbs. Engine was needed and it was found necessary to pack throttle valve before allowing it to go out.

11.30 a.m., pressure 120 lbs., commenced blowing off water.

11.50 a.m., pressure 70 lbs., water was all out.

11.57 a.m., pressure was zero, boiler was empty.

Work on empty boiler was done from 11.57 to 12.03.

12.03 commenced heating with live steam.

12.08 p.m. cut off steam; boiler pressure was 60 lbs.

12.09 p.m. commenced filling with superheated water.

12.16 p.m. boiler showed 2½ gages of water, and pressure was 70 lbs.

In 46 minutes the pressure in boiler was reduced from 120 lbs. to zero; six minutes' work was done on boiler, and it was filled and heated up to 70 lbs. steam pressure.

Locomotive No. 167—Arrived at roundhouse with 95 lbs. steam, and no fire. Engine was marked up for repair shop. Water was blown out and the steam pressure was allowed to drop to 65 lbs. in 25 minutes, after which the locomotive was moved to repair shop by its own steam at this pressure.

Locomotive No. 165, 2-8-0 class, was heated up from empty cold condition by use of live steam to allow locomotive to be moved to another stall.

9.23 a.m., cold; no water in boiler.

9.48 a.m., steam pressure was 123 lbs., at which time the steam was shut off.

At 9.53 locomotive was moved, and when in new stall pressure was 90 lbs.

Water Change.—Passenger locomotive No. 301—Atlantic type. Fire was banked; steam pressure 100 lbs. Two gages water before commencing. Water was changed in 37 minutes, and pressure did not drop below 75 lbs.

The pumps, the blow-off tank, the condensers and all of the plant, excepting the parts located in the roundhouse, are under the care of the power house men. One man in the roundhouse at 18 cents per hour does the work of changing water in boilers, heating and filling boilers, testing, etc., and he can handle two locomotives an hour if they are delivered to him so that he can operate on two or more at one time. At McKees Rocks roundhouse there are 10 stalls equipped for the use of this plant, and four trucks are used in making the connections to the boilers.

In conclusion, some of the advantages resulting from the use of the above plant have been found to be as follows:

1. Work of filling and emptying boilers and of changing the water is done without causing destructive strains in them.

2. The roundhouse work on boilers is more economically done in regard to labor, fuel and time.

3. Locomotives can be, and are, maintained in better condition, as work can be done when needed on parts of the boiler not accessible without removal of the contents.

4. The roundhouse conditions can be much improved. The floor will be cleaner and dryer, and the air will be free from smoke and steam, much to the benefit of the employees and of the structure.

5. Great economy resulting from the amount of heat saved from the water and steam blown out of boilers and used in heating water for other boilers.

6. Convenience of method of making hydrostatic tests of boiler strength, and the thoroughness of the operation results in the boilers being maintained in safer condition.

7. On account of the quick service in roundhouse work, passenger locomotives are run on schedules, with shorter time at terminals, thereby increasing the amount of work that can be done by the locomotives.

The Circum-Baikal Railroad.

The opening of the Circum-Baikal Railroad took place Sept. 23. The building of it has been one of the most notable feats in railroad construction. Probably no work of such difficulty was ever so quickly executed—some two years ahead of the time set before the war. Its importance to the Russians cannot easily be exaggerated, and its opening (doubtless it cannot be called completed yet) so early in the season immensely strengthens the position of the Russian army in Manchuria; which cannot only be reinforced but supplied for the winter before winter sets in, which in that terrible climate limits materially the efficiency of a railroad; though, the snow-fall being light on most parts of the line, there is less hindrance from blockades than we are accustomed to here. The new railroad is strongly occupied by troops, and is worked strictly as a military line. So far, only freight trains run over it, passengers crossing by the ferry in a fraction of the time required by rail, the distance by lake being less than 40 miles, against 250 by rail.

Three-Phase Alternating Current for Electric Railways.

During a discussion at the International Electrical Congress held at St. Louis, Sept. 13, Mr. A. Zelewsky, Chief Engineer of Ganz & Company, Budapest, Hungary, called attention to some of the advantages of the three-phase system for electric railway service. Extracts from his remarks follow:

It is generally stated that the series motor, the torque and speed of which are in intimate connection, is the most suitable machine for traction and transportation, while the polyphase induction motor, the behavior of which is rightly compared and made almost identical with the d. c. shunt motor, does not meet the requirements of railroad service. At the present time, railroads are operated principally by steam, which means the use of heavy locomotives and trains. When introducing electric power, we still have to deal with this condition and have also to build locomotives of large capacity. Attempts were made at starting single motor cars at short intervals, but this did not satisfy the requirements of the traveling world, which wants to be transported with the smallest possible number of stops; only for local traffic, therefore, is that method satisfactory.

It is impossible to think seriously of railroad service with heavy trains, without keeping strictly accurate time as laid out in the time-tables. The fundamental requirements of safety and reliability compel us to do so. I doubt very much whether it is possible to meet these requirements with a motor, the speed of which depends upon the voltage and upon the torque demanded, and which, therefore, is sensitive to any grade of the road and any change in the load, if artificial means for the regulation of the speed are not applied.

The regulation of speed, with single-phase series motors, not considering the parallel and series connection of two motors which is proper to both the d. c. and a. c. systems, can be effected by the insertion of either inductive or ohmic resistance or by the application of a transformer with variable ratio, which, however, will lower the power factor. But the motorman has to be very careful and pay the greatest attention to the controller in order to maintain the schedule. The speed of the polyphase railroad system, however, is almost independent of the pressure and load, and, therefore, within the limits of the capacity of the locomotives, trains of any weight on roads of any grade, can be propelled with the same speed, since the small retardation due to the slip at higher loads is easily within the elasticity of the time-table.

With high-speed locomotives, the resistance of the air rises considerably so that the ratio between the operating torque and the torque which is necessary to accelerate the train is not so unfavorable as with street railways. The requirements, therefore, to design an induction motor with sufficient high starting torque, can be easily met. Since polyphase induction motors operate with full torque up to almost synchronous speed, whereas the series motor can develop the maximum torque, only during a fraction of the accelerating period, it follows that in the first case the train accelerates in the shorter time, or in the same time, and with less jolting. Furthermore, the adhesive weight of the locomotive during acceleration is more fully utilized than with the corresponding series motors.

Although the application of water rheostats for starting, speed regulation, etc., somewhat lowers the efficiency of the system, this is of little importance on the main line roads. On the other hand, the starting apparatus, which is generally the most delicate point in all of the traction systems, is, on account of being a water rheostat, almost indestructible. Another great advantage of this system is the ability to send back energy to the power house on the descending parts of the road.

From the point of design and construction, motors for railway service should be as light as possible and the space between the tracks should be occupied by as much active material as possible. It is difficult to find space for the commutator when using single-phase

series motors. The conditions are still worse when we consider that the use of a transformer is necessary, the weight of which can again be considered as not entirely active on account of the variable torque which does not allow the transformer to operate at full efficiency all the time.

Not only have extensive experiments to prove the adaptability of the polyphase induction motor system for railway work been made, but such a railway system almost 70 miles long exists and has been in actual and continuous operation for more than two years, and the results are so satisfactory that a considerable extension of the system is only a question of a short time. The normal output of the locomotives in this system is 1,200 h.p., but they can carry a considerable overload, so that even the heaviest trains can be hauled on this very mountainous road. In Canada a combined polyphase and direct current railway system is to be built by Ganz & Company for local and interurban service.

Preliminary Railroad Surveys by the Stadia Method.

BY J. A. MACDONALD.

In making preliminary location surveys for railroads, the stadia method enables the surveying party to go over the field much more rapidly and in most cases is a much cheaper method for that reason than using a level. Locating engineers, however, seem to have a decided preference for using a level for this work, chiefly because of the more accurate data obtained. It would seem to be a useless refinement to go over the ground with a level taking precise but tedious readings at every station when these levels may only be furnishing rough data to the engineer from which the final location can be determined. In a level country or on gently undulating ground, the final location can often be determined with no preliminary observations, and the levels for the sub-grade fixed from one survey but usually all of the work of the preliminary survey must be done over once and often many times before the line is finally located. The stadia method is a simple and rapid way of obtaining all of the necessary data with sufficient accuracy for the purpose intended since both the topography and the bearing of the tangent can be found with one setting of the instrument.

The instrument best suited for a stadia survey is an accurate transit with a full vertical circle rigidly attached to the axis of the telescope and graduated to 30 seconds from 0 deg. to 90 deg. in both directions. The horizontal vernier arm should have a level attachment with a sensitiveness corresponding to the angle read by the verniers, for it is upon this level that dependence must be placed for the accuracy of the vertical readings and not upon the levels mounted on the horizontal vernier plate.

The stations in a stadia survey need not be placed exactly one chain apart but can be taken 200 ft., 500 ft. or even 1,000 ft. apart if the ground is level. After setting up the instrument on a station and getting the back sight the telescope can be circled around and all of the topography to the left side of the line taken. The rodman can be signaled to place his rod where wanted and the angles of elevation of all hills and valleys within 1,000 ft. should be obtained. Three observations are sufficient for most cases, one between 0 deg. and 90 deg., one at or about 90 deg. and one between 90 deg. and 100 deg. The elevation and distance of the next station should then be taken and finally three more observations recorded for the topography of the ground to the right of the line, one between 180 deg. and 270 deg., one at 270 deg. and one between 270 deg. and 360 deg. The azimuth or deflection of the tangent can be deduced from the offsets. Progressing in this way, the topography of the country through which the road is to pass can be plotted with reasonable accuracy, and the chief engineer with the data at hand can determine the exact location from the plot so made.

When working in the field with a stadia, a stadia rule, or even better, graphic diagrams should be carried for making the corrections for differences in elevation between the transit and the stadia rod or ½ sin 2 (observed angle) and corrections for distance, $\cos^2 \theta$. The constant of the instrument, f + c, may or may not be reduced to sine and cosine for small angles of elevation. The stadia rules are more convenient to handle than tables and the graphic diagrams are even easier to read. Any good draftsman can easily prepare a diagram for $\cos^2 \theta$ and $\frac{\sin 2\theta}{2}$ from which corrections can be read direct for any observed angles.

The most difficult part of a stadia survey is keeping notes in handy form. No note books can be obtained which are ruled up especially for stadia work but anyone can prepare such a book with little trouble. A convenient form is to have the facing pages ruled as below.

Page 4 ..... Observer ..... Recorder ..... Page 5 ..... Date.....

Station Number	Deflection Angle	Degree of Curve	Bearing of Tangent	Points Taken	Azimuths	Distances	Corrections	Vertical Angles	Computed Difference of Elevation	Elevations	Observations & Remarks

Ruling for Note Book for Stadia Surveys.

Both the left hand and right hand pages are used and no room is left for the sketch which should accompany the field notes. This, however, may be put on the two following pages and the notes continued after the sketch. Since the stadia reading must be corrected for differences in elevation it is better to enter the observed vertical angles and afterwards check the corrections with tables. In the distance column the corrected distance can be entered with the observed distances.

Foreign Railroad Notes.

The London "tuppeny" tubes, as the new electrical underground railroads are called, have hardly met with the favor expected. All three of them had fewer passengers in the first half of this year than last. The decrease was very slight, but notable because the number of omnibus passengers increased meanwhile.

The Prussian State Railroads lately asked for bids for 660,000 pine, oak and beech ties, in 670 different lots. Pretty much all the dealers, home and foreign, in such materials were on hand. Higher prices had been expected because low water in Russian rivers had prevented the arrival of what has usually been a large part of the supply; but, in fact, the bids were lower than at the last previous letting, which is attributed to the fact that a certain German forest had been so nearly destroyed by caterpillars that it must all be felled at once. The prices varied not only for different woods, but for the place of delivery. Pine ties at Hamburg were offered at 72½ to 87½ cents each; at Breslau, 52 to 63 cents.

The Railway Signal Association.

The annual meeting of this Association was held at St. Louis October 11 and 12, President J. C. Mock in the chair. President Mock in his opening address recommended the republication of the Proceedings of the Association from the beginning and the establishment of a permanent headquarters. The principal discussion was on a set of standard specifications for mechanical interlocking material and construction, reported by the committee on standards, of which Mr. C. A. Christofferson (C. G. W.) is chairman. A report of this discussion must be deferred to a future issue.

The committee on circuits for manual block systems, C. H. Morrison (Erie), chairman, made a report recommending (1) the use of the staff system on single track and (2) the controlled manual on double track, and embodying condensed descriptions, with drawings, of the electric train staff and the controlled manual apparatus as made by the Union Switch & Signal Company. There was some criticism of the committee's recommendation of the staff, on the ground that controlled manual block signals, without the staff, are equally safe. After considerable discussion a motion to endorse the second recommendation was voted down, and the report was recommitted, with instructions to prepare a report on the merits of different methods of controlling manual signals. The Illinois Central is now using, on 238 miles of its single track lines, so-called manual controlled signals, made by the Taylor Signal Company, which, however, have no rail circuit connection and are habitually used for giving permissive signals. The main function of the machine is to provide electric locking from station to station which insures that for each clearing of a signal the signalman must have the co-operation of the man at the other end.

Mr. Balliet (L. V.), chairman of the committee on wire circuits, reported that he had been unable to gather much information concerning the life of rubber insulated and weather-proof wires for the reason that very few roads had had any experience. It would appear from the discussion that there has been so much demand for low prices that weatherproof insulation, as now offered, is of a poorer quality than in former years. The discussion branched out into all manner of questions about line wires, and a resolve was offered that line wires should be at least as large as No. 10 B. & S. or No. 12 B. W. G., where poles are more than 132 ft. apart, but as a number of members are satisfied with smaller wires there was opposition to the motion and it was lost.

Dr. Black, of Milwaukee, who read a paper on tests of colored signal glasses at the September meeting, read a further paper on the subject at St. Louis.

The secretary's report showed a membership of 329 and the treasurer's report a balance on hand of $855. The old officers were re-elected except that H. S. Balliet (L. V.), of South Bethlehem, Pa., was chosen Secretary and Treasurer in place of B. B. Adams. It was voted that the next annual meeting be held at Niagara Falls.

Prevention of Collisions.

[*From The New York Evening Post.*]

The terrible collision near Warrensburg, Mo., last week was almost precisely like that at New Market, Tenn., two weeks before; and the two together resulted in the death of between 80 and 90 passengers. During the first six months of 1904 no less than 388 persons have been killed on American railroads. It is a black record. The potential causes of railroad wrecks are constant. The engineer forgets an order. The conductor has a copy of the same order, but he forgets it, or is unable to prevent the engineer's error. A train is directed to wait for two other trains, and it waits for only one of them, then going on to its destruction. There is nothing mysterious about the causes of these collisions which now agitate the public mind.

About 15 per cent. of the railroad mileage of the country has the block system, the well-approved method under which the number of collisions is enormously reduced; but on the other 85 per cent. passengers and trainmen—particularly trainmen—are added to the death list month after month and year after year with distressing regularity. If the people are to make their indignation effective, attention must be concentrated on one class of accidents—collisions. Collisions constitute the great bulk of the disasters which give American railroading so bad a reputation abroad.

There is practically only one remedy—the block system. All railroad managers know this. They put the block system in force on their busiest lines, thus justifying the assertion of the Interstate Commerce Commission, in its last annual report, that this is the only recourse. The only reason for the absence of so simple a safeguard is the cost; but this plea is greatly overworked. One prominent railroad manager said, not long ago, that the block system had been introduced on several hundred miles of his road at an increase in the pay rolls of the telegraph operators and signalmen of only 3 per cent. This was not one of the largest trunk lines, and the protection afforded was less complete than that which we find on some of the eastern trunk lines and on the well-equipped railroads of England; but it did greatly reduce the collisions and the death lists.

The block system means that no train starts on any part of the road until the line is ascertained to be clear of all other trains *for a known distance.* Without the block system, trains running in the same direction can be kept safely apart only by holding them a certain number of minutes at stations, and by the use of the discredited red flag; while on a single-track line the avoidance of collisions between trains running toward each other depends upon unerring adherence to the time-table, perfect care and vigilance, unfailing memory of rules, time-tables, and the superiority of different classes of trains, and attention to diverse distracting duties under the most trying circumstances of weather and overwork. The block system, on the other hand, makes all trains of equal importance (as regards safety), makes the "danger points" fixed instead of variable, and does away with errors from defective watches, misreading of time-tables or written papers, and forgetting telegrams.

Consideration of the block system does not (at present) require notice of such refinements as the automatic stop, used in the subway to check a careless motorman. Neither can there be much profit in considering, just now, the question of overwork of trainmen, or of the influence of the trade unions. The majority of collisions are due to the error or neglect of men in good health and not overworked. The Government bulletins are full of cases of collisions where those responsible are reported as having good past records.

It is fair to say that in some quarters progress in adopting the block system has been delayed by the desire to wait for the invention of more perfect apparatus. American railroad officers believe—though Englishmen have not yet adopted this view to any extent—that the ideal block system is the automatic. It costs very much more to install than does apparatus for the non-automatic or manual system, hence managers do not easily get the necessary appro priations. But this waiting attitude is indefensible, for the crying need is the immediate adoption of *some* block system; the use of manual signals pending the perfection or more general approval of automatic signals. One prominent trunk line whose approved standard is the automatic, has yet put in the manual system on many miles.

The dilatory policy of the railroads has now continued for so many years that they can find no fault if Congress takes radical action. The Interstate Commerce Commission, in its last annual report, laid before Congress a definite measure, and there has been no adverse criticism of it. On the contrary, the manager of one important trunk line declared his intention of preparing to comply with a law like that proposed, which contemplates complete block signaling within five years. As we said at the time, the Interstate Commerce Commission is the most appropriate body to exercise governmental supervision in this matter. With all its faults, it has done fairly well with the Federal statute of 1893, making automatic couplers and air-brakes compulsory everywhere. The people of the country have a right to require of railroads a reasonable assurance of safety, and the way to enforce this right is now quite plain. The railroads have had their chance to make a good showing; too many have neglected it, and their showing is appallingly bad. Unless the managers act of their own motion in adopting safety appliances, the only thing they have to expect is a mandatory law with heavy penalties for its violation.

Railroad Shop Tools.

(*Continued.*)

RADIAL DRILLS.

The accompanying illustration, Fig. 1, shows a 60-in. radial drill made by the Dreses Machine Tool Company, Cincinnati, Ohio. This machine is shown in connection with a speed variator and a constant speed motor. The outside column swings on an inside stump fixed to the base and reaching almost to the top, and it is clamped by a split band encircling part of the fixed stump and a flange on the lower end of the column. Power is transmitted to the drill spindle in the usual way by a horizontal shaft near the base, a pair of miter gears and a central shaft in the column, two spur gears on top of the column and an outside vertical shaft V carrying a sliding miter gear. This miter gear engages with the miter gear on the short shaft (see Fig. 2), on which are fixed the pinion b, and the two loose friction gears c and d. The pinion b meshes with friction gear e, and the friction gear c meshes with friction gear f on shaft h. The friction gear d engages indirectly with f by means of the intermediate pinion g journaled in the gear casing. The lever combination j operates the double friction in gears e and f, and when engaged with one or the other, changes the speed according to the proportion of the gears, which is in geometrical progression with the range of

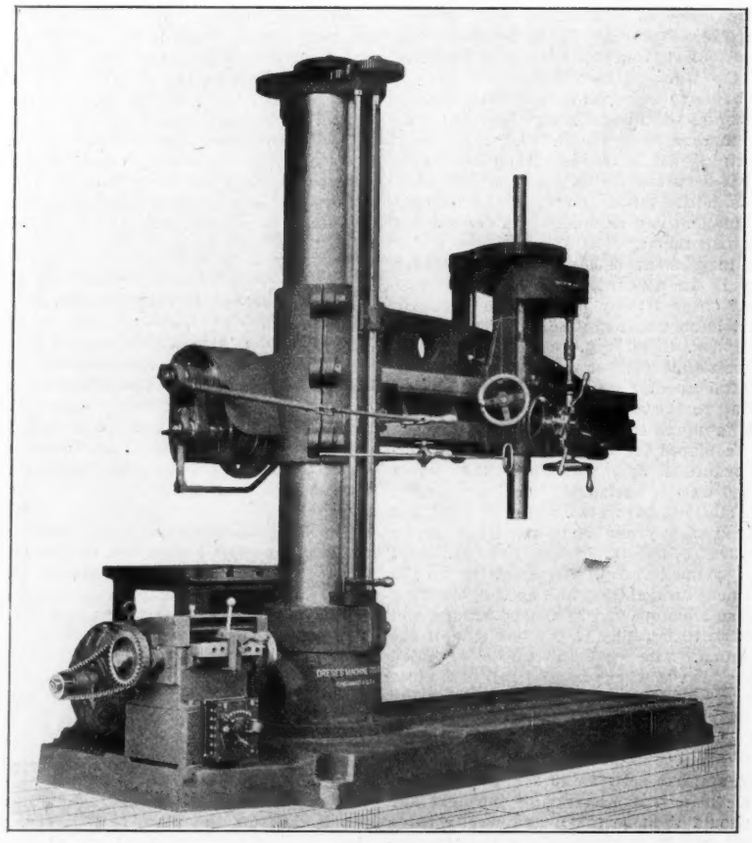


Fig. 1—The Dreses Radial Drill.

the cone pulleys. The double friction between the gears c and d is operated by the lever combination K, and when engaged with c the spindle turns to the right. When engaged with d, because of the intermediate gear g, the spindle reverses faster in the same ratio as the different diameters of the two gears c and d. By clutching d to shaft a, a slow forward speed and fast reverse is obtained by engaging the friction between e and f alternatively. By clutching f to h and operating the friction between c and

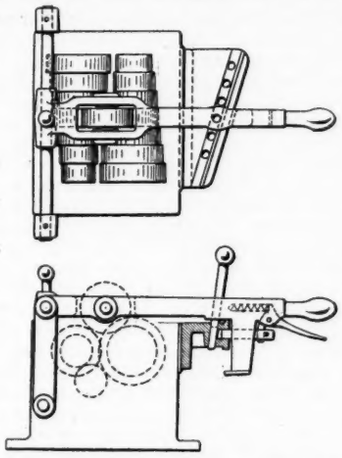


Fig. 3—Main Drive Variable Speed Mechanism.

d a fast forward and a slightly increased reverse speed of the spindle can be had.

The power feed for the drill spindle is geared. It has six changes and is varied by shifting the knurled knob on the feed rod, which engages the proper gear by a key and feather gear.

The speed variator has two shafts with seven gears on each shaft proportioned for seven speeds in geometrical progression. These gears do not mesh with each other, but are fixed to the shafts, except the largest driven one on the variable speed shaft, which is connected by a pawl and ratchet arrangement. This ratchet gear and the smallest gear on the driving or constant speed shaft are connected through an idler pinion which causes the driven shaft to run always at the slowest speed. When the speed of the variable speed shaft is increased the ratchet fixed on this shaft runs ahead of the pawl in the loose gear. The lever with the handle shown in front of the speed variator swings in the rear on a bridle and it is arranged so that it can be shifted either lengthwise or crosswise. It carries a single gear wheel which meshes with the different gears on the two shafts. The latch with the plunger below the handle, locks the handle vertically and the knobbed pin locks it horizontally, as shown in Fig. 3. The holes for locking, in the index plate, are drilled to correspond to the correct positions of the intermediate gear in mesh with the cone gears. These cannot be engaged unless the intermediate gear is in the correct position. In order to take up the shock of rapidly changing from low to high speeds, and *vice versa*, a frictional connection between the drill shaft and the variator is introduced. This friction is similar to a planer friction, and is adjusted so as to carry the heaviest load of the machine, but no more.

Fig. 4 shows a combined radial drilling and tapping machine made by the Newton Machine Tool Company, Philadelphia, Pa. The radial arm of this machine measures 6 ft. from the center of the

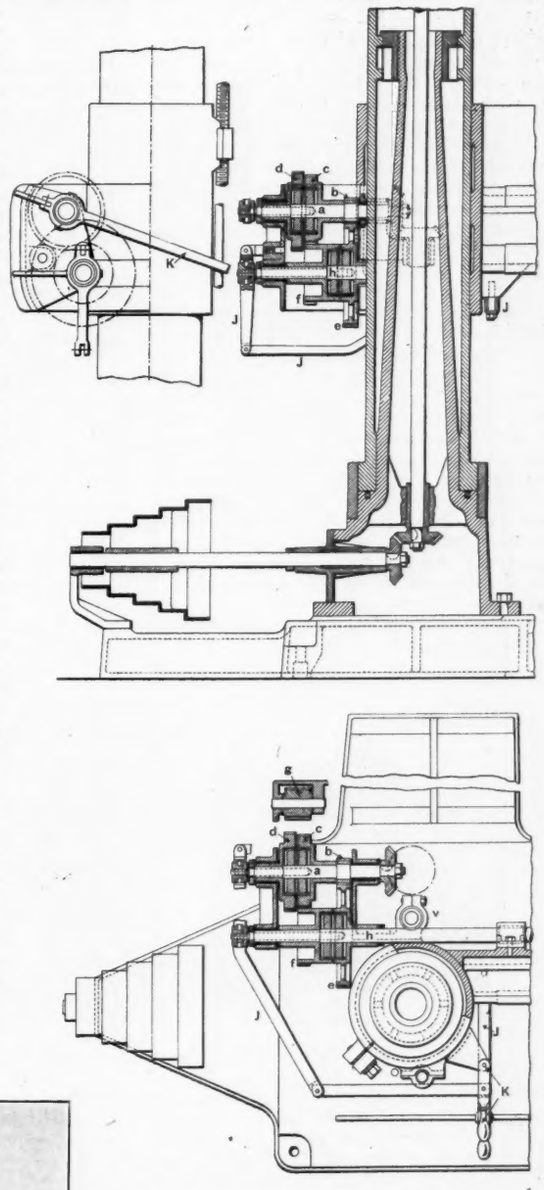


Fig. 2—Details of Mechanism for Obtaining Additional Spindle Speeds.

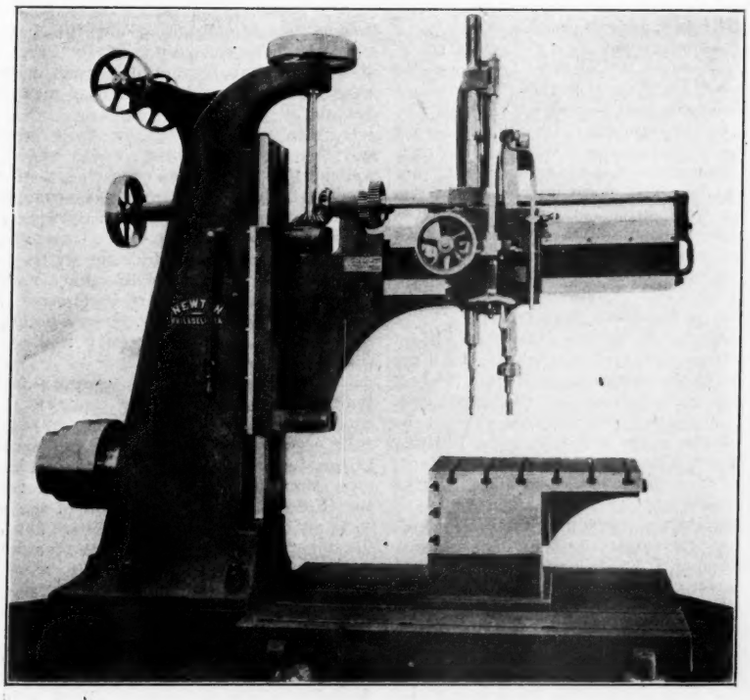


Fig. 4—The Newton Radial Drill.

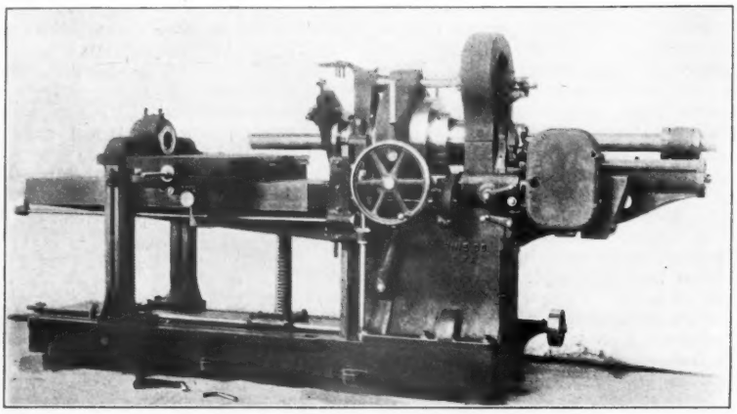
trunnion. Two spindles are provided, one for drilling and one for tapping. These spindles are $2^{13}/_{16}$ in. in diameter; they are counterbalanced and both have an automatic feed of 17 in. Three changes of feed are provided for the drilling spindle, which is driven through a worm and worm wheel by a three-step cone with back gears. These gears are on the horizontal driving shaft on the radial arm. The tapping spindle is geared to the main spindle with a reduction of 2¼ to 1 for tapping, and the reverse speed for backing out the tap is the same as the speed of the drilling spindle. When not in use the tapping spindle remains idle. The movements of the tapping spindle are controlled by a clutch which is operated by the lever shown in front of the saddle. The advantage of this tool over the radial drill with tapping attachment is, that it is not necessary to change the speed of the machine, or in other words, to throw in the back gears for tapping after the hole is drilled, since the reduction of the speed is obtained by the gearing. By having two spindles, the necessity of changing the drill and placing the tap-

ping head in the spindle is also obviated. One revolution of the hand wheel, which is used to traverse the carriage, will bring the tapping spindle directly in line with the hole drilled. This adjustment of the tapping spindle is controlled by an index point on the hand wheel shafting. The maximum distance between the end of the spindles and the base of the machine is 74 in. and the over-all dimensions of the base are 4 ft. x 9 ft. A work table 21 in. wide x 39 in. long is provided, and it is arranged with a swivel bearing so that holes may be drilled at an angle.

(To be continued.)

Exhibit of the Gisholt Machine Company at the World's Fair, St. Louis.

The exhibit of the Gisholt Machine Company, Madison, Wis., at the World's Fair, St. Louis, consists of three sizes of standard turret lathes; one big-bore turret lathe having a swing of 24 in. and a 5-in. hole in the spindle; three sizes of vertical boring mills; one 60-in. horizontal drilling and boring machine, and one Gisholt Universal tool grinder. The newest tool among these is the 60-in. horizontal boring and drilling machine shown in the accompanying illustration. Double friction back gears are provided in the headstock and the boring bar, which is of hammered crucible steel, is ground with a taper socket to hold supplementary boring bars of small sizes. The feed mechanism is the same as that used on Gisholt turret lathes. It consists essentially of a coarse pitch screw geared to the spindle and gives a positive feed. No extra attachment is required for screw cutting. Generating levers are placed on both sides of the machine so that it can be controlled from any point. By the movement of a lever convenient to the operator, the table can be raised or lowered by power and accurately adjusted at any required height. The cross table has a compound movement and is fitted with a cross feed when desired. Both the transverse and longitudinal screws for moving the cross table are fitted with micrometer index dials reading to .001 in. The yoke for the table is cast with a box section and is clamped to the table instead of being bolted with bolts sliding in T slots. It carries double bushings for the support of the boring bar.



The Gisholt Horizontal Drilling and Boring Machine.

An engineman while his freight train was being made up in Ferrara left it in charge of the fireman, who, it seems, knew how to start but not how to stop it, and it ran away with him down the main track and into an express train entering Ferrara, killing 7 and wounding 16.

The American Street Railway Association Convention.

The twenty-third annual meeting of the American Street Railway Association was held in the reading room of the Transportation Building at the World's Fair, St. Louis, October 12th and 13th. President W. Caryl Ely, of Buffalo, N. Y., called the meeting to order and introduced Hon. David R. Francis, President of the Louisiana Purchase Exposition, who addressed the convention. After referring to the wonderful growth and expansion of electric railways, President Francis related the history of the intramural railway project. The original plan was to have the road built and operated by the street car companies as a joint project, the cars from their city lines to run over it. This was abandoned, and the exposition management had about concluded that the crowds could be handled by automobiles. President Francis did not concur with this idea and undertook to have an intramural road built and operated by the exposition authorities, in which plan he was successful. The road carries on an average of 55,000 persons daily—about 55 per cent. of the paid admissions to the grounds—and is one of the best sources of revenue that the exposition management has.

If it had not been for the electric street railways it never would have been possible to have had such an exposition, as it would otherwise have been impossible to bring the crowds to the grounds. One of the great problems of the management was this matter of conveyance of the people to and from the grounds. The street railways met the situation with entire success, and what is of greatest importance, they appear to have the good will of the community and of the thousands of strangers who are their patrons.

Following President Francis, Prof. W. E. Goldsborough, of Purdue University, Chief of the Department of Electricity, told the members of the things of particular interest to street railway men at the exposition. After enumerating the different exhibits he spoke of the work of the Electric Railway Test Commission, which is doing a large amount of experimental work in testing modern electric railway apparatus and in determining various factors which bear on the operation of street railway equipments, which have as yet not been fully investigated. It covers the operation of the braking system, both by air storage and compressors on cars. Also the matter of the reactance of rails, or the resistance due to the flow of an alternating current through a rail. The commission has on the north side of the Transportation Building two tracks 1,400 ft. long, with three modern equipments for test purposes. The commission intends conducting a series of experiments on an 8-mile tangent in Indiana, in which the cars will be run at high speed to determine wind pressures. The pressure on the body will be determined, and different shaped vestibules tried on both ends of the cars. It is hoped to attain speeds of 70, 80 and even 90 miles an hour.

Mayor Wells, of St. Louis, who had been detained, was next presented and addressed the convention briefly, extending the welcome of the city, and touching on the growth of the latter and the important part the street railways had had therein.

President Ely then delivered his address. He congratulated the Association upon having selected the World's Fair as its place of meeting because of the opportunities it offered of viewing the highest results of the inventive genius and progressive labor of man in the development of transportation of all kinds as well as in the arts, sciences, trades and manufactures. He reviewed the work of the past year in the electric railroad world, referring to the electrification plans of the New York Central and the Pennsylvania, and the operation of single-phase alternating-current motors on the Schenectady Street Railway by the General Electric Company. Speaking of the electrification of the Manhattan elevated system of New York he said: "The electrification of the Manhattan Elevated Railway system, which was finally completed in June, 1903, in which month the last steam train was taken off, has during the p st year enabled a direct comparison to be made between the operation of the system by electricity and steam. It has been determined that the substitution of electricity has increased the carrying capacity of the road 33 per cent. as indicated by the actual increase in car-mileage; the passenger traffic has been increased 30 per cent.; the operating expenses have decreased from 55 per cent. of the gross receipts in 1901 to 45 per cent. in 1903, and all obnoxious vapors, smoke, steam and cinders incidental to steam locomotive operation have been eliminated from the streets traversed by the railroads of the system. The wisdom of the enormous expenditure of money necessary to make the change has been fully demonstrated by the benefits which have accrued not only to the people of the city but to the intelligent management which at such great cost made the change."

He also spoke of the New York subways and the advantages they would afford, as well as the methods of operating them and keeping them in condition. He next quoted from a paper by Mr. Frank J. Sprague read before the recent session of the International Electrical Congress in which the writer dwelt on the many advantages that have resulted from the general use of electric street railways, and discussed somewhat whether or not the electric motor would replace the steam locomotive.

Mr. Ely referred to the growing feeling that the form and scope of the Association work required remodeling, one of the results of which, growing out of the discussion at Saratoga in 1903, has been the formation of a Manufacturers' Association, to relieve the Street Railway Association of the onerous duty of providing for exhibits. The Manufacturers' Association also provides for the entertainment of the members, with the knowledge and approval of the Executive Committee. He said in conclusion:

"A careful inspection of the proceedings of the conventions of the last few years reveals the fact that the most of the time of each convention has been occupied with the reading and discussion of papers embracing

subjects which for the most part relate to the small technicalities of the business, nearly all of which might have been profitably committed to proper auxiliary and subsidiary organizations. Broad fields of co-operative effort in the most important lines of our work have remained almost untouched. It becomes immediately apparent upon investigation and discussion of the situation that we might profitably enter upon the discussion of the greater questions affecting our welfare. The confusion of laws throughout the country affecting our corporations is a matter to which we might well devote attention. There are also such great questions as taxation, municipal ownership of street railways, franchise rights and obligations, statutory laws affecting our class of companies, municipal laws and ordinances, and other questions of importance to which your minds will readily refer. The collection and preservation of data tending to throw light upon the problems of great importance that confront us is also a matter deserving of attention, and in this regard it would seem that through the medium of the secretary's office and of appropriate standing committees an invaluable collection of data could be made and permanently preserved in such form as to be conveniently accessible to any member of the association upon merely making request of the secretary. If the work of the secretary's office should be made continuous there would thus grow up in time a vast repository of valuable statistical and historical information, readily available as a matter of right to every member. This branch of the work alone, if properly prosecuted, would render membership in this association so valuable that it is difficult to understand how any street railway corporation would feel justified in remaining outside of this association. It is our duty to keep in step with the changes in conditions that confront and surround us; we must be in synchronism with the spirit of things; we must not hesitate to make necessary and beneficial changes nor should we be deterred by our consideration of the past.

"It is undeniable that notwithstanding the fact that the intelligent and broad-minded policies that to-day characterize the operation of the great properties represented in this association, and notwithstanding the fact that inestimable advantages have been and are being thereby conferred upon the entire public within your individual spheres of action, there exists to-day a tremendous amount of misunderstanding of your labors and the effect thereof upon individuals and communities. Intelligence must replace ignorance; darkness must give way to the light. There are to-day no matters or things really in difference between yourselves on the one hand, and the public on the other. With right understanding there will come about perfect accord. The remnants of old suspicions founded upon misconception and misunderstanding must be swept away. It is only by a general diffusion of information concerning our properties and our work that public appreciation may be obtained. Let us bury all questions of prerogative, precedence and personal advantage and unite in a vigorous and persistent effort to bring out of present conditions such a state of organization and work as will not only meet with the intelligent and hearty approval of all those comprised in our different organizations, but will also put us in closer touch with the public whom we serve, and tend to the creation of such a condition of things as will enable us best to work out legitimate ends and purposes."

A resolution was offered proposing to rescind that part of the resolution adopted at the Saratoga meeting which requested the technical press to refrain from the daily publication of proceedings. This was at the close of the first day's meeting, and on motion action was deferred until the following day. At the opening of Thursday's session this resolution was amended by substituting for "proceedings" the words "verbal reports of discussion," and was adopted.

The Secretary reported the addition of nine new members during the year and the loss by suspension and withdrawal of 19, leaving a membership of 196. The balance in the treasury was $7,646.

The recommendation of the Executive Committee, that the Association amend its by-laws to provide for an increase in the size of the Executive Committee sufficient to accommodate as members, the presidents of such auxiliary organizations engaged in street railway work as may be approved and fostered by the American Street Railway Association, and that the Executive Committee be empowered to act in the matter to bring about its accomplishment, was adopted.

The committee on rules for the government of conductors and motormen reported a rearrangement of the standard code in order to provide for the insertion of such special rules as might be required by various companies, in their proper places under the different headings. The committee directed its efforts toward making the interurban rules conform, as nearly as conditions would permit, with the standards adopted by the American Railway Association.

Mr. Vreeland offered a resolution to empower the President to appoint a committee of nine members, whose duty shall be to increase the membership of the association. There are at the present time over 600 street railway companies operating in the territory covered by the association, of which only 196 are members. The resolution was adopted.

The discussion of papers followed. The paper on "Steam Turbines" by Mr. Richard H. Rice was the first presented. An abstract of this paper, under the title "Small Curtis Turbines," was printed last week.

Mr. C. O. Mailloux (New York) offered some interesting information in regard to turbines, the result of observations made during a European trip last summer. He was prejudiced at the outset, believing that the steam turbine was unsuited to driving direct-current generators because of its speed, but what he saw in European practice had changed his views. He had seen 250-k.w. units running at 2,500 r.p.m. and smaller units running at 3,000 and 4,000 r.p.m. He was glad to see a line of small turbines for direct connection being developed in this country, that is turbines without gears. He thought it better to allow higher generator speeds and connect directly, rather than to use gearing. One use to which small turbines are being put in Europe is driving centrifugal pumps for boiler feed. They have great advantages because of the absence of reciprocating motion, the feed being absolutely steady. In reply to a question about danger to the turbine from water in the steam, he told of a case of a mine installation where a 250-k.w. low-pressure turbine was driven by the exhaust steam from a 1,500-h.p. hoisting engine, through an accumulator, and though the plant had been running two years there was no record of difficulty, although the steam could not be very dry.

Mr. S. M. Hopkins (Columbus, Ohio,) told of a case of a 500-k.w. turbine which temporarily had to be run, taking steam from a long line. As the steam entered the line superheated, no provision was made for draining the line. The condensation in the line was so great that a reciprocating engine also taking steam from it could be started only with the greatest difficulty. But the turbine never gave any trouble, even with considerable quantities of water going through it. Describing some comparative tests between two 500-k.w. turbines and two tandem-compound Green-Wheelock engines with a cylinder ratio of 6 to 1, taking steam from the same boilers and under the same conditions of superheat, he said they figured the B. T. U. per electrical horse-power and found that the engines showed the higher efficiency. The tests included one-third load, half load, full load and 50 per cent. overload; but after comparing the results and taking the whole proposition into consideration, he regarded the turbine as the superior generating unit. All guarantees for turbines are based on water consumption alone, and also include clauses regarding certain degrees of superheat. The idea was to apply the superheat to the engine also and see if it would be as valuable as to the turbine. The results showed it to be even more so, but there was considerable trouble in lubricating the engine cylinders, particularly the high-pressure. But the results of the tests yielded the conclusion that in buying apparatus they should not be misled by guarantees in regard to superheat.

It appeared from the testimony of some members that trouble had been experienced from water where superheated steam was used. Mr. Mailloux explained that it was mechanical entrainment due to defective design of piping or boilers, or to the operation of the latter, and could be remedied by the use of a receiver near the turbine, or a separator. Referring to the matter of steam economy of the turbine, he said that the makers do not claim the highest economy under all conditions; that they recognize that it is more efficient in the lower stages. A prominent English engineer had proposed using the reciprocating engine for the higher pressure stages, say 200 lbs., expanding down to 10 or 15 lbs. gage, and using a low-pressure turbine with condenser; that the turbine under these circumstances would be enabled to develop as much power as the engine at the higher pressure. Again, regarding economy of operation, there are other factors beside fuel economy entering into the case. What is wanted is the total cost reduced and in that equation enter many things, like space, maintenance, repairs, etc.; and the bulk of evidence up to the present time indicates that the turbine will make up in other things for a slight discrepancy against it in steam consumption. There was a steam engine in Berlin built by one of the most distinguished firms in Switzerland, a triple expansion, four-cylinder compound engine, a 5,000-h.p. unit, which running at very nearly full load gave a performance of something less than 9 lbs. of water per i.h.p. hour with superheat up to 600 deg. F. or more. That is perhaps the world's record up to the present time, but that engine had 16 valves, complicated mechanism, and a great deal of lubrication was required. It has been stated that doubtless the cost of maintenance and the cost of the extra lubrication of the cylinder, lubrication of the valve motion, etc., and all the expenses connected with the operation of that unit make it less economical when considering the total cost per annum of producing the power. So it is an important thing to bear in mind that one of the reasons why the steam turbine appeals to us is that it simplifies the operation and reduces the maintenance of the plant in other respects than that of economy of coal. The steam turbine has only begun its development, and the more it is developed the more it will approximate the results obtained by the steam engine.

Mr. Thomas Hawken (Dover, N. H.) stated that they have two 500-k.w. units which have been in service three months and are giving the greatest satisfaction. They carry fluctuating loads and the regulation is excellent.

The coal consumption is 4 lbs. per k.w. hour. They had begun operations by cooling their lubricating oil, but water would get into it and it would saponify, resembling lard. The people supplying the oil advised that it was unnecessary to cool it for temperatures under 400 deg. and subsequent results with temperatures of 140 to 160 deg. verified the claim.

Mr. W. H. Abbott (Cleveland) said they got a deposit resembling crude vaseline in the oil chamber and had been unable to correct the difficulty, which they found rather serious.

The next paper was on "Steam Turbine Power Plants" by Mr. J. R. Ribbins. Asked if relative economy of high vacuum for turbines as deduced in his paper would not apply equally well to reciprocating engines, Mr. Ribbins stated that turbines will expand down to condenser pressure and can be designed to take advantage of a high vacuum, which engines cannot do directly.

Referring to the matter of air in the water from leaks, the question was asked if open or closed feed-water heaters would be preferable under the circumstances. Mr. Hopkins (Columbus, Ohio) told of two installations, one having an open and the other a closed heater, both using the same form of air pump, and practically no difference could be observed as to the quantity of air in the water.

Mr. E. D. Meier's paper on "The American Diesel Engine" was next presented. Mr. Meier expanded considerably the remarks made in his paper, going more into detail regarding the characteristics of this interesting engine. He said Diesel had succeeded in burning powdered coal in the cylinder of his engine, but because of the clinker, which must inevitably form where coal is burned, the thing is not of practical utility; but it was clearly demonstrated that it can be done. The principal difference between the American and European design is in the method of feeding the oil, it being necessary to devise for the former a scheme whereby the oil, such as is bought in open market, would not be carbonized in feeding. The European method is adapted only for refined oil. The largest units built at present in this country are 450 to 500 h.p. In Germany a 600-h.p. six-cylinder unit is being built for use in street railway and lighting work in Russia, and they expect to get up to 1,000 h.p. within another year. The cost of Diesel engines at present is from $60 to $70 per h.p. for the plant; but it must not be overlooked that there are no boilers, smoke-stack, coal handling machinery, ash removal, etc., to be considered.

TRANSFERS—THEIR USES AND ABUSES.

This paper, by Mr. Leon Jewell, states briefly the advantages that have resulted from the establishment of transfer systems in their effect on promoting traffic, etc. The abuses, which constitute the disadvantages and result in loss to the companies, are likewise enumerated, following which is a history of the origin and development of the transfer system of the Chicago City Railway Company, with which the writer is connected. Some interesting data on the growth of the system are offered covering a period of 20 years. The uses and abuses are summarized as follows:

Uses.—(a) To increase the transportation facilities, whereby passengers can be carried in different directions, by shorter and more direct routes. (b) To offer additional inducements to ride, thereby creating and developing increased traffic. (c) To better serve the traffic of each individual line. To reduce the number of direct through lines and decrease car mileage.

Abuses.—(a) The improper and fraudulent acts of conductors in connection with the handling of transfers. (b) The brokerage or trafficking in transfers, especially by newsboys. (c) The improper transferring and exchanging of transfers by passengers. (d) The possible increase of damage claims, arising from the operation of a transfer system.

In the discussion which ensued President Ely stated that the form of transfer in general use was so condensed and so abstruse that it was unintelligible to the average person; in fact, that in law cases that had occurred in connection with abuses of transfers, even the courts were not clear as to what the transfer slip comprehended; therefore it was hardly to be wondered at that wholesale abuse is possible. He thought a remedy might lie in the adoption of an enlarged form, so designed as to admit of a minimum possibility of misunderstanding and thereby eliminate one source of, and excuse for, present abuses. A form suggested as offering possible solution was similar to the coupon tickets of steam passenger roads.

Other members appeared to consider the transfer abuse matter pretty nearly hopeless; that it would continue to be so as long as the almost universal desire of persons to get something for nothing exists.

A resolution by Mr. Vreeland empowering the Executive Committee to employ such clerical or expert assistance as it may deem desirable, and fix the compensation therefor, was adopted.

The committee on compensation for carrying United States mails submitted a progress report and stated that it believed the conditions would soon be favorable for having the matter favorably considered by the Government.

The officers for the ensuing year are:

President, W. Caryl Ely, President International Railway Company, Buffalo, N. Y. (re-elected).

First Vice-President, Elwin C. Foster, President New Orleans Railways Co., New Orleans, La. (re-elected.)

Second Vice-President, John I. Beggs, President & General Manager the Milwaukee Railway & Electric Light Co., Milwaukee, Wis.

Third Vice-President, Richard McCullough, Assistant General Manager St. Louis Transit Co., St. Louis, Mo.

Secretary and Treasurer, Thomas C. Penington, Treasurer Chicago City Railway Co., Chicago.

Executive Committee: Presidents, Vice-Presidents and John J. Stanley, General Manager Cleveland Electric Ry. Co., Cleveland, Ohio; Howard F. Grant, Manager Seattle Electric Co., Seattle, Wash.; C. G. Goodrich, Vice-President Twin City Rapid Transit Co., Minneapolis, Minn.; Frank G. Jones, Vice-President and General Manager Memphis Street Railway Co., Memphis, Tenn.; W. E. Harrington, General Superintendent Public Service Corporation of New Jersey, Camden, N. J.

The selection of the time and place for the next convention was left to the Executive Committee.

An Overhead Foot Bridge for Small Stations.

The accompanying illustration is of an inexpensive foot bridge which the Engineer of the London & South-Western has recently adopted as standard for use at country stations on that road. It is 45 ft. 6 in. long, 14 ft. clear above rail level, and is 4 ft. 6 in. wide. The trusses are 4 ft. 6 in. deep and the top members and also the stairways are formed of 3½ in. x 3½ in. x ½ in. angles. The bottom members are of 4½ in. x 3½ in. x ½ in. angles, with 3 in. x 3 in. x ⅜ in. angle braces. The supports are somewhat unique, being simply four 12 in. x 6 in. I-section rolled steel joists embedded in concrete blocks and inclined from the vertical in two directions in order to neutralize the effects of moving loads and wind pressures. Each bridge weighs about eight tons only and is provided with wrought-iron hand rails and wire mesh safety guards in the panels. It forms a neat and adaptable design, and, while it has proved itself, under test, to be amply strong for full loads, its extreme lightness demonstrates that a minimum of material is used to good advantage. The cost of foundations, erection, painting, etc., all complete, does not exceed $1,000.

Overhead Footbridge for Small Stations in England.

It is reported that the Russian government has given a charter for building a railroad from Tashkend, in Central Asia, on the Asiatic Midland, northeast, nearly parallel with the Chinese border, to the Siberian Railroad near Tomsk, a distance of about 1,500 miles, with the condition that the capital for it must be raised outside of Russia. The prospects for such a line are much better than might be supposed. There are immense deserts, or semi-arid regions, to the west of it, and barren mountains and desert to the east of it; but the streams flowing down the west slopes of these mountains, before they are absorbed by the western deserts, make a considerable belt of fertile land; and already there are important settlements in the foot-hills two or three hundred miles south of the Siberian Railroad (but not so far from navigable streams which cross that railroad), attracted by good land and important mines of coal, iron and copper, the most valuable in Siberia.

GENERAL NEWS SECTION

THE SCRAP HEAP.

A press despatch says that some locomotives of the Denver & Rio Grande are to have electric headlights with the adjustable mirror in front to throw rays of light vertically towards the sky, and that these rays will be colored red.

At the Schenectady shops of the American Locomotive Company piece-work men have been notified to expect a falling off in the amount of work to be done, and one statement is to the effect that 2,500 men will be laid off; also that the office force will be reduced.

Railroad Commissioner Colquitt, of Texas, says that a report sent in to the Commission by the San Antonio & Aransas Pass shows that in one month public officers traveled 84,000 miles over the lines of that company on free passes. Evidently not all of the citizens of that State hate the railroads; or, if they do, some of them must be contemptible ingrates.

Mr. L. K. Gillett, Assistant Inspector of watches for the Atchison, Topeka & Santa Fe and the other roads of the Santa Fe system, tells a Houston reporter that his duties as traveling inspector keep him on the road all the time, and that it takes him about two years to visit the inspection points on the Santa Fe lines. He says that the cost of the watch inspection department is $18,000 a year. Each test of a watch lasts 72 hours and if it varies six seconds during the time it is rejected.

For Safety in Case of Collision.

Newspapers in Alabama say that on the Southern Railway passenger trains are now made up with the parlor and sleeping cars next to the baggage cars; behind these come the day coaches and at the rear the mail car.

Pig Iron Production for September.

The *Iron Age*, in its report for the month of September, shows that the total anthracite and coke pig iron production for this month amounted to 1,352,677 tons, as against 1,167,672 tons in August, 1,106,297 tons in July, and 1,292,030 tons in June. The increase has taken place chiefly among the steel companies. The September production of these companies was 936,494 tons, as against 747,570 in August, 694,892 tons in July, and 788,822 tons in June. The number of stacks in blast on October 1 was 191, as compared with 182 on September 1; and the weekly capacity was 309,946 tons, about 1,200,000 tons per month.

Patent Decision on End Train-Pipe Steam Heat Valves.

The Chicago Car Heating Company announces that a recent decision of the patent office gives it the exclusive right to make end train-pipe valves attached to the steam heat train line for operation from the platform by means of a vertical shank running up into the platform and attached to a horizontal rod which controls the spindle and seat of the valve. The formal patent covering these broad claims has been issued after two years delay caused by an interference suit which was decided in favor of the Chicago Company. (Interference No. 23,215—E. H. Gold vs. R. M. Dixon, decided July 9, 1904, in favor of E. H. Gold. Patent No. 771,777, "Car Heating Apparatus," issued to E. H. Gold, Oct. 4, 1904.) With long passenger trains and wide vestibuled coaches, end valves operated from the platform have come into general use, and there are several designs which this patent decision is understood to affect.

Hearing Concerning Private Cars.

The investigation of the use of private cars on the railroads of the United States, made by the Interstate Commerce Commission at Chicago last week, and briefly reported in our issue of October 14, was continued on the following day. Additional testimony was given concerning the payment of heavy rebates to shippers of fruit in California, but the reports do not say what railroad carried this fruit. Testimony was given to the effect that on many shipments of fruit the railroads pay—presumably to shippers or to car owners, or to these combined—commissions of 12½ per cent. of the freight rate. Another statement was to the effect that certain shippers received commissions of 6¼ per cent. George F. Mead, of Boston, Vice-President of the National League of Commission Merchants, said that on peaches from Georgia 12 cents a crate had to be paid for icing. The icing charge on a car from Georgia to Boston was $66. Another witness said that shipments over the Illinois Central cost $54 a car for icing, but similar lots were iced for $30 a car when sent from a station where the Armour Company had no contract. The contract of the Armour Company with the Pere Marquette Railroad is said to be for a term of seven years. Testimony was given to the effect that the National Car Line is owned by the National Packing Company.

The Acme Water Storage System.

The Acme Water Storage & Construction Company, New York, exhibits at the St. Louis Exposition an apparatus which produces a constant supply of water under high pressure for tall buildings, country residences, small municipal water works, etc. The apparatus is intended to displace water towers and elevated tanks. It consists of two tanks, each 5 ft. in diameter and 10 ft. long, and an air compressor and a pump operated by a single 5 h.p. gas engine. The pump is of the Deane vertical, triplex, geared type, and is fitted with 4-in. cylinders; the plungers have a stroke of 6 in. The pump is designed for a pressure of 100 lbs. per sq. in. and a speed of 47.3 r.p.m.; the speed of the gas engine is 280 revolutions. The operation of the apparatus is as follows: One tank is kept constantly charged with air at a high pressure, while the other contains both air and water, the air being admitted to the second tank from the first by a pressure-reducing valve set to give constant pressure in the second tank. The water is forced into the tank by a pump. The entire contents of the water tank may be used under a constant pressure without operating either the compressor or pump, and it is necessary to run the latter only at such times as are found convenient for charging the system. As the water is pumped into the water tank the air is removed by the compressor and returned to the air tank, so that the water pump always operates against a uniform pressure.

B. & O. Medals at St. Louis.

The elaborate and costly exhibit of locomotives and historical models made by the Baltimore & Ohio Railroad at the World's Fair, at St. Louis, has won "all of the medals that could possibly be awarded to a railroad company" and a gold medal of honor has been awarded to Major J. G. Pangborn, the director of the exhibit. As our readers know, Major Pangborn has been the active manager and custodian of this great historical collection from its inception in 1892. The highest award is the gold medal for the best and most attractive exhibit, only one such medal being awarded in the Department of Transportation. The next is the "Grand Prize," also a gold medal, for the Baltimore & Ohio section as a whole, and with this go 18 collaborators' medals, for the men who have contributed to the value of the display. Besides these, the B. & O. receives a gold medal in the group of Engineering and Architecture, in the Department of Liberal Arts, for the model of the new union station at Washington, which is the central feature of the B. & O. section in the transportation building. Altogether, this list comprises four gold medals and 18 other medals, most of them gold.

The jury in the department of transportation consists of Vice-President J. W. Kendrick, of the Atchison, Topeka & Santa Fe; J. B. Berry, Chief Engineer Union Pacific; J. W. Thomas, Jr., Vice-President and General Manager, Nashville, Chattanooga & St. Louis; D. Van Alstyne, Superintendent Motive Power, Northern Pacific; W. G. Berg, Chief Engineer, Lehigh Valley; B. A. Worthington, Assistant Director Maintenance and Operation, Southern Pacific and allied lines; Henry Bartlett, Superintendent Motive Power, Boston & Maine; Howard D. Taylor, Superintendent Motive Power, Philadelphia & Reading; Theo. H. Curtis, Superintendent Motive Power, Louisville & Nashville; H. F. Ball, Superintendent Motive Power, Lake Shore & Michigan Southern; W. C. Arp, Superintendent Motive Power, Vandalia Line; W. H. V. Rosing, Assistant Superintendent Motive Power, Illinois Central; Richard H. Phillips, Civil Engineer, Louisiana Purchase Exposition; W. H. Brimson, General Superintendent, Baltimore & Ohio Southwestern; S. M. Felton, President, Chicago & Alton; W. M. Grafton, Signal Engineer, Pennsylvania Lines; Mr. Steinbiss, Director of Railways, Germany; Henri de Grieges, France; W. Baron van Ferstel, Austria; Emil Probst, Austria (alternate); M. Serroys, Belgium; Felix Gain, Belgium; F. E. Cuming, Great Britain (alternate); Keihiu Takayangi, Japan. The awards of this jury are confirmed by the superior jury, of which Governor Francis is the head.

Street Railroad Damage Suits in New York.

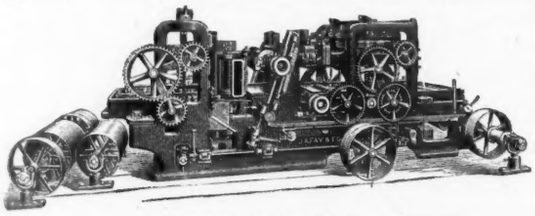
Out of 7,712 actions included on the Supreme Court Trial Term calendar, prepared last summer, no less than 1,912 are accident suits against railroads. The percentage is almost one in four, and the street railroads of the city are the defendants in about ninety-five out of a hundred of the accident suits. Add to these the number of actions that have been begun since the compiling of the calendar, and the total will not fall far short of 2,500. The calendar for this year has been divided into three sections: "railroad," "tort" and "contract and other" cases, and four courts have been specially set aside for the trial of railroad accident suits. The amount sued for in these cases varies from $500 to $100,000 and may be averaged at slightly over $7,000, which would give a total sued for on the calendared cases alone of about $14,000,000. It will be seen that in order to prevent the absorption, not alone of its earnings, but of its capital, the New York City Railroad Company, which now includes all the street railroads of Manhattan, is forced to fight these suits with vigor. Not more than one in three plaintiffs, however, gets a verdict, and in the ultimate result, after appeals and retrials, barely one in eight. As the average verdict in the end does not exceed $2,000, the company in the long run pays out barely 3 per cent. of the total sued for in the Supreme Court. In the City Court, and the branches of the Municipal Courts, innumerable accident suits are brought, but the amount recoverable is limited in the City Court to $2,000, and in the Municipal to $500. As a rule judgment against the company is more quickly and easily obtained in the lower courts. Verdicts rarely go beyond the Appellate Term, which is a midway appeal court between the City and Municipal Courts, and the Appellate Division. "Ambulance chasing," as the *Law Journal* remarked the other day, "has become a sort of universal profession in this city." No matter where or when an accident occurs, there are always on hand some people who seem to make it their special business to let a certain class of lawyers know the name and address of the injured person.

The injured man is pestered till he either makes a selection or kicks the whole bunch out of doors. In the majority of cases the patient, being ill, poor or ignorant or a mixture of all three, tinged with a burning desire to "get back" at the corporation, be he right or wrong in his claim for damages, succumbs easily to the persuasion and extravagant promises of the lawyer. Should he have any scruples they are soon swept away by such talk. Then the retainer is signed, almost invariably guaranteeing the lawyer half the proceeds of the suit.

The company's detectives succeed so often in unearthing gross and deliberate frauds that in the nature of things they suspect fraud where none is intended. But recently two lawyers have been sent to Sing Sing for participation in such frauds, which are the harder to discover because of the comparative ease with which they may be concocted.—*New York Sun.*

Accident Bulletin No. 12.

Government Accident Bulletin No. 12, for the months of April, May and June, 1904, shows 23 passengers and 144 employees killed, and 1,134 passengers and 1,244 employees injured in train accidents, and total casualties to passengers and employees 12,095 (677 killed and 11,418 injured). The number of employees killed in coupling and uncoupling cars during this quarter was 60, being a decrease of 10 from the preceding three months. The total number of collisions and derailments was 2,418; damage to cars, engines and roadway, $2,015,252. For the year ended June 30, 1904, there were 3,787 killed and 51,343 injured, an increase of 233 killed and 5,366 injured over the previous year. These figures do not include casualties at highway crossings, to trespassers, to employees in shops, etc. The number of passengers killed in train accidents in the year was 270; in the year before, 164; nor trifling accidents to employees which did not prevent them from performing their accustomed service for more than three days, in the aggregate, during the ten days immediately following the accidents.



Double-Cylinder Timber Dresser.

A New Nut-Lock.

The accompanying illustrations show a new nut-lock which is simple and effective. The bolts are made in the ordinary way except for the slot, which is made while forming the bolt and is ⅛ in. deep and 1/16 in. wide on all sizes of machine and track bolts. The nuts are hot pressed, and when punching the thread hole a corrugated cup 1/16 in. deep is also formed into the nut with the same operation. The ring is made from 1/16 in. steel and has an inwardly-projecting lug which works freely in the slot in the bolt. The ring, or washer, is slipped on the bolt like an ordinary iron washer, the nut following. As the nut is tightened it forces the washer into the corrugated cup, which acts as a ratchet and allows the nut to be tightened to the extreme tension and yet leaves the washer free inside the cup.

A New Form of Nut-Lock.

The chief advantage of this device is that the nut can be removed without injury to the thread of either bolt or nut, by forcing the latter backward with a quick, strong motion which shears the lug from the washer, about 90 lbs. pressure being required. The lug drops out through the slot in the bolt, allowing the nut to be removed freely. In replacing the nut a new washer is added, when the operation may be repeated. The ratchet formed by forcing the washer into the corrugated cup against a plate, even though the nut be not tightened to the greatest tension, will still hold the nut in place and not allow it to work back on the bolt and be lost. The Border Bolt & Nut-Lock Company, Richmond, Ind., is the maker.

Double-Cylinder Timber Dresser.

The timber dresser shown in the accompanying illustration is a powerful machine, heavily built to prevent vibration when it is working to its full capacity. It will plane timbers on two or four sides up to 30 in. wide and 20 in. thick, or two sides and one edge of two timbers each 13 in. wide and 20 in. thick. The feeding mechanism consists of six rolls, the two in front being divided and geared in the center so that two pieces of uneven thickness can be planed at once. All of the upper rolls are driven down to give a powerful drive and the feeding-out roll is geared at both ends. The lower feeding-in rolls are mounted on inclined slides and can be lowered 1 in. below the line of the bed for dividing an extra heavy cut between the top and bottom heads. The lower cylinder of the machine is placed between the top cylinder and the feed rolls. It has an independent vertical adjustment and is belted from the feeding-out end; it can be withdrawn at the side for sharpening or changing the knives. The pressure over the lower cylinder is exerted by four large rolls each having an independent lift. The feed is controlled from the side or front and has either tight and loose pulleys or a cone and clutch attachment; to get at the inside of the machine the feed platen may be removed. This machine is also made in a smaller size to plane 20 in. or 30 in. wide by 16 in. thick. J. A. Fay & Egan Company, Cincinnati, Ohio, is the builder.

Annual Meeting of the Pullman Company.

At the annual meeting of the Pullman Company held in Chicago October 13 the former Board of Directors was re-elected as follows: Marshall Field, O. S. A. Sprague, Henry C. Hulbert, Henry R. Reed, Robert T. Lincoln, Norman B. Ream, William K. Vanderbilt, J. Pierpont Morgan, Frederick W. Vanderbilt, W. Seward Webb, Frank O. Lowden. The usual quarterly dividend of $2 per share from net earnings was declared, payable November 15th to stockholders of record at close of business October 31.

The total revenue for the year was $24,788,730. The total expenses of operation were $12,254,160; depreciation on cars, and reserve for depreciation on all the property of the company, $2,318,874; dividends declared, $5,919,976; proportion of net earnings of cars paid to associated interests, $554,095, leaving a net surplus of $3,741,625. The net assets of the company are $92,017,375, of which $74,000,000 is represented by capital stock and $18,017,374.87 is surplus, which is $3,741,625 more than a year ago.

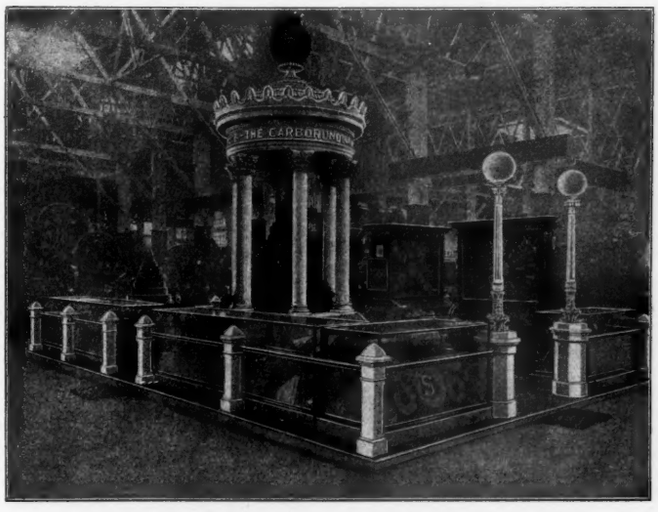
Contracts for the operation of cars have been made with the El Paso & Northeastern, El Paso & Rock Island, Gulf & Ship Island, Interoceanic of Mexico, and the West Jersey & Seashore. The number of passengers carried during the year was 13,312,668, and the number of miles run by cars was 408,234,382; passengers the previous year, 12,321,260; car-miles, 389,254,410; showing an increase of over 8 per cent. in the number of passengers carried, and about 5 per cent. in the number of miles run. The total mileage of railroads covered by contracts for the operation of this company's cars was 180,035.

The value of the manufactured product of the car works of the company for the year was $22,838,400, and rentals amounted to $304,360, a total of $23,142,760, against $22,885,689 for the previous year. The average number of names on the payrolls at Pullman for the year was 6,915, and wages

paid $4,996,997, making an average of $722.63 for each person employed. The total number of persons in the employ of the company, in all departments, was 20,355, and the wages paid during the year amounted to $12,570,914.

The Carborundum Company's Exhibit at St. Louis.

The exhibit of carborundum of The Carborundum Company, Niagara Falls, N. Y., in the Machinery Building at the St. Louis Exposition, is shown in the accompanying illustration. In the center of the exhibit is a handsome dome supported by columns, under which is a large mass of carborundum crystals. Surrounding the dome are a number of glass cases in which are shown a few of the 80,000 different forms and grades into which carborundum is classified and sub-divided. The special object of this exhibit is to show the many and important uses to which carborundum is put. A large book of testimonials, made up of letters, from prominent industrial works which use carborundum is shown. A 24-in. chilled-iron roll, from the J. T. Noye Company, Buffalo, partly ground, shows the work done by carborundum. The Noye Company states that a carborundum wheel 10 in. in diameter by 1 in. thick removed 8,710 cu. in. of iron, and that a carborundum wheel will grind a roll 9 in. x 36 in. in 4½ hrs. This same work was formerly done with a steel tool and took 13 hrs. Carborundum wheels are shown doing actual work in the adjoining exhibit of the Landis Tool Company, Waynesboro, Pa. Another exhibit showing a full line of carborundum products is to be seen in the Mining Building in connection with the Niagara Falls exhibit.



The Carborundum Company's Exhibit at St. Louis.

Graft on the Railroad.

Graft is an insidious and indefinite thing. The rights which the grafter appropriates as his own are the secondary incidents of the transaction in which he acts for his principal. The possibilities of graft press the railroad man on every hand. They range all the way from the tip to the train porter, who turns the car seat in violation of orders, to the share of the promoter's profits accruing to the director who votes the purchase of an overcapitalized road. Some of these are the recognized perquisites of the place which the employee holds; others merge into the doubtful territory where standards of right and wrong are not well fixed, and finally others are recognized to be wrong, but are tolerated in lax practice, so that the employee runs little personal risk.

Sometimes the baggage man accepts a tip for prompt service, and may be further induced to ignore a slight excess in weight of baggage; the station agent gives preference to a favored shipper's loaded meat car, and in consequence his family never pays a meat bill, or he is able to assist, as his interest dictates, the local shipper to place his orders for empty cars. He finds it possible, in a small way perhaps, to permit freight to lie in the warehouse longer than the rule permits, or he winks at the wrong classifying or the underweighing of freight. In cases of extraordinary laxity of administration he serves favorite shippers with extra switching without charge. The purchasing agent conforms to all the formal requirements of calling for bids and keeping records open to inspection, but he can buy at special times, or he can impose exceptional conditions whose effect is to debar all but the favored supply man. The engineer and the master mechanic can impose specifications that are extraordinary in ordering supplies, or they can pass upon the relative merits of new types of signals or switches or structural material or machinery in such a way as to give preference. The returns for this service can come in so many indirect ways that it would be impossible to generalize. The car supply man is in a way to specially serve some of the larger industries on the road, and it would be impossible to tell just exactly when and how much was the preference given. The traffic man can find reasons for shading of rates which no other man can gainsay, but the rates serve the purpose of protecting favored industries. The freight line owned by railroad officials is an abuse which has pretty nearly been eliminated from railroad operations to-day, but there are still a few which thrive when the conditions which served to justify them have ceased to exist. Sometimes the commission exacted reaches 10 per cent. of gross earnings of freight passing over the lines.

Most of such tonnage would move without the interference of the line at all, and the line commission is little less than direct robbery of the stockholders.

In these days of joint operation of railroad property the traffic man can divide the rate as he sees fit between mileages which represent different financial entities. The earnings of weak sisters can thus be bolstered up at the expense of the main property and the real deficit made good before it appears on the balance sheet.

The terminal company or the bridge company which collects excessive toll is another form of mulcting the stockholders for the aggrandizement of an inner clique.

Expensive officialdom is another form of possible graft which can fasten itself on an old railroad property. Great organizations require a state department and a diplomatic corps, and there is a very large legitimate expenditure for the mere courtesies and amenities of officialdom. Such a department looks out for the political complications. Checks and counter checks alone are inadequate to protect the revenues. The fairest railroad in the land when prey to grafters would have small surplus to turn over to the stockholders. The auditor performs a definite and sacred function, but he has his limitations both of ability and of prerogative.
—*Wall Street Journal.*

Fatalities on British Electrically Operated Railroads.

The British Board of Trade has recently issued three separate reports dealing with fatal accidents due to persons coming in contact with the live rail on the portions of the Lancashire & Yorkshire and the North Eastern which have recently been converted from steam into electrically worked roads. The first report deals with an accident on the Lancashire & Yorkshire in which a man who was trespassing on the line, being ignorant of the danger, stepped on the live rail and was instantly killed. In England the law is very severe against unauthorized persons walking on the track, and the railroads are under no obligation to provide safeguards for the lives of trespassers. Employees are supposed to be aware of the danger from the live rail, but, as an additional safeguard, the Lancashire & Yorkshire has protected the power rail at all points where employees, other than trackmen, have any occasion to be on duty or on business. Near the stations and at sidings and signal towers the rail is protected by single or double boarding, and at the few grade road crossings the power rail ends 6 ft. away from the fences on either side, and is protected by double boarding for a distance of 10 ft. from the end. The power rail is unprotected for the greater part of the distance, but the only employees who are required to expose themselves to any danger on the unprotected sections are the trackmen. The tools which they use, however, are insulated, and no accidents have occurred among this class of employees. The Board of Trade recommended that it was not necessary to protect the live rail for the whole length of the line, since the only persons exposed to danger are the trackmen who are aware of the danger, and persons who are trespassing, for whom the railroad company is not responsible.

The other two fatalities reported upon occurred on the North Eastern. One of these was a porter employed by the company, who was killed while performing his ordinary work, and the Board of Trade gave especial consideration to the case. The man was found dead on the line at the eastern end of one of the stations and had apparently stepped on the live rail without thinking of the danger. The live rail which caused his death was not protected by any guard boards at this point. The other fatality on the same road was the case of a small boy who was trespassing on the line.

The inquiry of the Board of Trade was directed mainly toward ascertaining the extent to which the live rail had been protected and the necessity of protecting it

throughout the entire length of the roads electrically operated. The consulting electrical engineer who designed the installation on the North Eastern was called and gave evidence as follows:

"There are two distinctive types of protection for the third rail. One is a type supported from the sleeper, and the other is a type supported from the rail. The difficulty in regard to the type supported from the rail is that in wet weather the woodwork becomes more or less of a conductor, and any iron work takes the potential off the rail as the result of surface leakage and the thorough soaking of all timber with water. The difficulty in regard to the type supported from the sleeper is that unless metal is used to support the timber it is difficult to make it sufficiently rigid. It interferes more with the upkeep of the track, and if metal is used for supporting the timber it brings the metal parts into close proximity to the third rail itself. Throughout the design of the whole work a minimum clearance of 6 in. from the rail to any metal parts in contact with earth, was used in the North Eastern installation, and we consider it dangerous to encroach upon this minimum distance. I do not think that protection could be done for less than $1,000 per mile of single track; this provides double guarding. In the present electrification scheme there is not less than 82 miles of track."

As a result of the inquiry the Board of Trade exonerated the railroad companies from all blame in all three cases and made no recommendations on the necessity of more complete protection, it being apparent that the installation of the live rail was in both cases protected as thoroughly as was feasible.

The Mersey Railroad.

On the Mersey Electric railroad of Liverpool the operating expenses for the first six months of 1904 were only $7,280 more than the corresponding period of last year, but the receipts increased $41,800, or about 25 per cent. The cost per train mile when the road was operated by steam locomotives was 60.2 cents, but since the change has been made to electricity this has been reduced to 34.7 cents, a reduction of 42 per cent. Nearly twice as many trains are now run as formerly and the service is improved in every way. The gross earnings per train mile are now about 48 cents, leaving net earnings of 13.3 cents per train mile.

Manufacturing and Business.

At the St. Louis Exposition the Grand Prize for mohair car plushes has been awarded to the Sanford Mills, Sanford, Me. (L. C. Chase & Co., Boston).

The Economy Car Heating Co. will remove its offices on November 1 from Portland, Me., to 170 Broadway, New York. W. S. McGowen, Jr., is General Manager.

The Canada Car Co., which is said to be an enterprise of the Pressed Steel Car Co., has been granted a charter by the Dominion Government; authorized capital $3,000,000.

A. O. Norton, of lifting jack fame, has arrived at Lake Massawippi, Quebec, in his 24 horse-power automobile, and is entertaining a party of railroad friends at his famous fishing preserves in the Lake St. John district, and at his unique and appropriately named summer home, "The-House-that-Jack-built."

The Union Drop Forge Co., Chicago, has been awarded a contract by the Chicago & North Western for supplying its entire system with "Union" drop-forged claw bars for one year.

The Everett Steam Motor Co., of Everett, has been incorporated in Massachusetts, with a capital of $200,000. Obed De Camp is President and Paul Sears, Treasurer, both of Everett.

The T. H. Symington Co., Baltimore, Md., has lately received orders for journal boxes for over 10,000 cars, including 4,000 for the Pere Marquette, 3,100 for the Erie and 500 for the Wabash.

The Jacksonville Bridge & Iron Co., of Jacksonville, Ill., reports say, is building an erecting shop 100 ft. x 140 ft. of brick and steel construction, in which a 15-ton crane with a 60-ft. span will be placed.

The Quebec Electric Company, reports say, will soon be in the market for about 600,000-h.p. hydraulic electric generating machinery for its works, which will be located at Ste. Anne and Seven Falls, Quebec.

The Wellman-Seaver-Morgan Company, engineers and manufacturers, with general offices at Cleveland, Ohio, have opened a New York office at 42 Broadway. Mr. Geo. B. Damon has been appointed the New York manager.

Bids are wanted November 1 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for band resaws, cross-cut saw, engine lathe, molder, etc., for the Mare Island and Puget Sound navy yards.

The meeting of supply and machinery dealers of the north, east and west, which was to have been held in Cleveland October 18 and 19, to organize, was postponed to a date not yet decided upon. The meeting is to be held in Cleveland.

The T. H. Symington Co., maker of railroad specialties, Baltimore, Md., state that it is arranging to put up a plant for making Symington journal boxes in the west, to take care of its western business.

The Northern Texas Construction Co., of Amarilla, has been incorporated in Texas with a capital of $250,000 to build railroads and bridges. The incorporators are: J. E. Caldwell and E. B. Stahlman, of Nashville; E. C. Gordon, and others, of Amarilla.

The Electrical Securities Corporation, of Schenectady, has been incorporated in New York with a capital of $3,000,000 to make and deal in electrical, gas, water and steam power machinery. The directors are: W. C. Lane, Pliny Fisk and others, of New York City; E. T. Stotesbury, of Philadelphia; Gordon Abbott and James J. Storrow, of Boston; M. J. Johnson, of Cleveland, and others, of Providence, R. I.; Morristown, N. J.; Flushing, N. Y., and Schenectady.

A recent installation of gas engines made by the Columbus Machine Company, Columbus, Ohio, is in the works of the Star Drilling Machine Company at Akron, Ohio. It consists of one 35 h.p. and four 60 h.p. Columbus gas engines. One of the 60 h.p. engines drives the woodworking machinery in one of the buildings, and another is used in the metal working department. The 35 h.p. engine operates the light plant, and the other two 60 h.p. engines drive air compressors.

The suit of the Kennicott Water Softener Company, Chicago, against the Industrial Water Company, New York, for infringement of patent resulted in the issuance of a perpetual injunction against the defendant in July last. The case was argued in the United States Circuit Court in New York City in April, and Judge Holt gave his decision a month later. A final decree was entered July 13th ordering a perpetual injunction and a reference to a Master for an accounting of damages and profits, with costs; the order being served on the defendant five days later.

The Lehighton Foundry & Machine Co., of Lehighton, Pa., has bought six acres of ground on which it will build new shops. Bidders are requested to submit their own plans and specifications to George I. Hull, 127 Worth street, New York, for a foundry 76 ft. x 160 ft., with a core room 60 ft. x 76 ft., a cupola room 25 ft. x 30 ft.; a machine shop, 50 ft. x 100 ft., with a testing room addition 40 ft. square, and a roundhouse 40 ft. x 100 ft., all of which are to be of iron frame construction with corrugated iron roofs and sides. The company will soon be in the market for machinery for its new equipment.

Bids are wanted Nov. 8, by the Bureau Supplies and Accounts, Washington, D. C., for machine tools at the Portsmouth, Boston, League Island, Norfolk and New Orleans navy yards, as follows: Lathes, planers, bending and straightening rolls, expanding machines, cutting-off machines, engraving machine, band-sawing machine, punching machine, milling machines, shears, helve hammer, steam hammer, air compressor, deck winch, drill, drill presses, car-wheel press, motor drives for various machines, traveling cranes, locomotive crane, centrifugal pump, steam pump, valve pump, steering engine and coal cars.

Iron and Steel.

The plate mill of the Lackawanna Steel Co. will begin operations shortly with a capacity of about 40,000 tons a month.

Reports from Sharon, Pa., state that Daniel Egan, of Philadelphia, former Vice-President of the American Steel Foundries Co., will build a steel casting plant in Sharon to cost about $300,000.

During September, there was shipped from various ports in the United States 8,490 tons of rails, as against 6,967 in August, and upward of 2,500 tons in July. The principal shipment was 3,200 tons to Beirut, Syria.

The increased demand for iron and steel has resulted in advanced prices. Some important sales are reported in Pittsburg. Members of the Bessemer Pig Iron Association ask $12.25 a ton, valley furnace, for Bessemer pig iron, for shipments to be delivered this year.

About 18,000 tons of rails, it is reported, will be sent to Korea during the next four weeks by the United States Steel Products Export Co., which handles the foreign trade of the United States Steel Corporation, all of which, it is stated, will be shipped from Tacoma, Wash.

At the annual meeting of the stockholders of the Colorado Fuel & Iron Co. in Denver, October 17, proxies for more than 90 per cent. of the stock were presented by John D. Rockefeller, Jr., and George J. Gould. At this meeting the reorganization plan was completed. The board voted to authorize a bond issue of $45,000,000 for the purpose of paying off certain indebtedness upon the property, to retire the debenture bonds and to provide a surplus and working capital; and $8,000,000 will be available for immediate use, of which more than half will be spent in making improvements to the plant. A meeting of the directors will be held next week to appoint officers.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies see advertising page 24.)

Canadian Society of Civil Engineers.

At the autumn session of this society, held October 20, a paper by R. W. Leonard, M. Can. Soc. C. E., on "Experiments on Loss of Heat from Iron Pipes," was read.

American Society of Civil Engineers.

At the meeting of this society October 19, a paper by C. C. Schneider, M. Am. Soc. C. E., on "The Structural Design of Buildings," printed in the September proceedings, was presented for discussion.

National Association of Railroad Commissioners.

The sixteenth annual convention of this association will be held at Birmingham, Ala., November 15. Among the committee reports which are expected are the following: Classification of Expenses of Electric Railroads; Grade Crossings; Classification of Expenses of Steam Railroads; Uniform Freight Classification; Legislation; Safety Appliances and Block Signals.

Franklin Institute.

At the meeting of the sections in the hall of the Franklin Institute, Philadelphia, October 19, the programme included a paper on "The Organization and Methods of a Modern Industrial Works," with illustrations, by J. Wilmar Henszey, of Philadelphia; and at the meeting on October 20, the subject presented was "Luminous Arcs," by Charles P. Steinmetz, of the General Electric Co., Schenectady, N. Y. At the meeting to be held October 27, the subject for discussion will be "Testing Machines," to be opened by William C. Du Comb, Superintendent of Tests, Riehlé Bros., Philadelphia.

PERSONAL.

—Col. James Boyd, President of the Stony Creek and the Perkiomen Railroad Companies, died at his home in Norristown, Pa., on Sunday, October 16, at the age of 83.

—Mr. William J. Croasdale, a well-known civil engineer, died at Moncton, N. B., on October 6, aged 78. Mr. Croasdale was at one time Government Engineer in Newfoundland, and took part in the survey and construction of a number of early railroads in Canada.

—Mr. John M. Culp, Fourth Vice-President of the Southern Railway, has been promoted to be Third Vice-President. Mr. Culp has been in the railroad service since 1870 and has been at the head of the traffic department of the Southern for many years. He was appointed Fourth Vice-President in 1902.

—Hon. Alonzo B. Cornell, Governor of the State of New York in 1879-1881, died at his home in Ithaca, N. Y., on Oct. 15, at the age of 72. Mr. Cornell was the eldest son of Ezra Cornell, founder of Cornell University. At the age of 14 he became a telegraph operator and in that business rose to be senior Vice-President of the Western Union Telegraph Company; and he was one of the directors of that company at the time of his death. He was interested in many railroad and steamboat enterprises, both in this country and South America.

—Mr. Charles Parsons, formerly (at different times) President of the South Carolina & Georgia, the Rome, Watertown & Ogdensburg and the New York & New England roads, died at his home in New York city on October 18, at the age of 75. Mr. Parsons was born at Alfred, Me., and before the war was in business in Savannah, Ga. He had important financial interests in New York besides those in the railroads mentioned, and was a member of the Stock Exchange at the time of his death. He is survived by Mrs. Parsons and six sons and daughters.

—Mr. Richard V. Taylor, of Mobile, the new General Manager of the Mobile & Ohio, to succeed C. S. Clarke, has been in the service of this company for the past 27 years. Mr. Taylor was born in 1859 at Newbern, N. C., and was educated at the Barton Academy at Mobile, Ala. He began his railroad career as a clerk in the accounting department in 1877, and until 1888, occupied various positions in that department. In the latter year (1888) he was appointed General Auditor of the company, which position he now leaves to go to St. Louis as General Manager.

—Mr. William D. Trump, who has been chosen to succeed Mr. Smith as General Superintendent of the Pere Marquette, is 40 years old. Mr. Trump's first railroad service was as a telegraph operator and agent in his native town, Milford, Mich., on the Flint & Pere Marquette. He was next made chief clerk in the Assistant Superintendent's office, and in 1892 held a similar position in the General Superintendent's office. Later he was made Superintendent, and afterwards Assistant General Superintendent of the system. He is now promoted to the General Superintendency, with office at Detroit.

ELECTIONS AND APPOINTMENTS.

Boston & Albany.—See New York Central.

Canadian Railway Commission.—Hon. Andrew G. Blair, Chairman of the Commission, has announced his resignation.

Chicago & Alton.—S. J. Campbell has been appointed Master Mechanic at Slater, Mo., succeeding F. P. Roesch, resigned.

Chicago & North Western.—W. J. Towne has been appointed Engineer of the Wisconsin and Northern Wisconsin Divisions, with headquarters at Chicago, Ill., succeeding C. T. Dike, who has been assigned to other duties on construction work. W. W. Gaffin, Division Engineer at Escanaba, Mich., has succeeded Mr. Towne at Baraboo, Wis., as Engineer of the Peninsula Division.

Chicago, Burlington & Quincy.—V. O. English has been appointed Acting Superintendent of the McCook Division, with headquarters at McCook, Neb., succeeding A. Campbell (Superintendent), who, owing to ill health, has been granted an indefinite leave of absence. F. Harris, Assistant Superintendent at Denver, will succeed Mr. English as Assistant Superintendent at Aurora, Neb.

Chicago, Milwaukee & St. Paul.—C. A. Fraser has been appointed Superintendent of Terminals at Chicago.

Chicago, Peoria & St. Louis of Illinois.—A. L. Rossetter has been appointed Master Mechanic, with headquarters at Springfield, Ill.

Chicago, Rock Island & Pacific.—At a meeting held on October 17, Robert Mather was elected President, to succeed Mr. Loree. E. B. Boyd having resigned as General Freight Agent of the Lines East of the Missouri River, T. H. Simmons, Assistant General Freight Agent, will have charge of all local traffic in East of the Missouri River territory, and H. A. Snyder, Assistant General Freight Agent, will have charge of all traffic in same territory originating at or destined to points on other lines East of the Mississippi River, and also traffic originating in same territory destined to points West of the Missouri River.

Chicago Terminal Transfer.—At a meeting held recently C. L. Raymond, W. H. Heaton, A. E. Goodhart and A. O. Slaughter were elected Directors, succeeding Henry S. Hawley, Charles W. Gould, Henry A. Rust and Otto T. Bannard.

Cincinnati, Hamilton & Dayton.—George R. Balch, Purchasing Agent, has resigned.

Delaware, Lackawanna & Western.—Riley Williams, hitherto Superintendent of the Bangor & Portland Division, has been appointed Terminal and Lighterage Agent, with office in New York city. He has been succeeded at Easton by George A. Poore.

Erie.—George F. Baker has been elected a Director, succeeding the late John Lowber Welsh.

Georgia, Florida & Alabama.—F. W. Armstrong, hitherto Assistant General Freight and Passenger Agent, has been appointed Acting General Freight and Passenger Agent, succeeding R. B. Coleman, General Freight and Passenger Agent, resigned. The position formerly held by Mr. Armstrong has been abolished.

Grand Trunk.—J. Wright has been appointed Acting Superintendent of Terminals at Port Huron, Mich., succeeding the late Mr. Begg.

Illinois Central.—George W. Becker, Assistant General Freight Agent at St. Louis, Mo., has been transferred to Chicago, Ill., succeeding J. R. Peachy, who in turn succeeds Mr. Becker at St. Louis.

Lake Shore & Michigan Southern.—W. K. Vanderbilt, Jr., has been elected a Director, succeeding E. D. Worcester, deceased.

Lehigh Valley.—Charles Wilson has been appointed Master Mechanic at Wilkesbarre, Pa., succeeding F. F. Gaines, resigned.

Missouri Pacific.—The jurisdiction of Alexander G. Cochran, Vice-President; Charles S. Clarke, Vice-President, and A. W. Sullivan, General Manager, has been extended over the St. Louis, Iron Mountain & Southern.

New York Central & Hudson River.—John Howard, hitherto Superintendent of Motive Power and Rolling Stock of the Boston & Albany, has been appointed Superintendent of Motive Power of the N. Y. C. & H. R., with headquarters in New York city, effective Nov. 1.

Oregon R. R. & Navigation Co.—J. H. Sterling has been appointed Auditor, with office in Portland, Ore.

Panama.—E. A. Drake, hitherto Second Vice-President and Secretary, has been appointed Vice-President, and the offices of First Vice-President and Second Vice-President have been abolished.

St. Louis & San Francisco.—The headquarters of R. R. Hammond, Second Vice-President, have been removed from St. Louis to Chicago.

J. V. Hanna, hitherto Principal Assistant Engineer, has been appointed Assistant Engineer of Maintenance of Way, succeeding M. C. Byers, who has been assigned to other duties.

St. Louis, Iron Mountain & Southern.—See Missouri Pacific.

Southern.—John M. Culp, hitherto Fourth Vice-President, has been appointed Third Vice-President, with office in Washington, D. C.

LOCOMOTIVE BUILDING.

The New York Central & Hudson River is in the market for 25 locomotives.

The Chicago, Burlington & Quincy is considering the purchase of 25 freight locomotives.

The New York, New Haven & Hartford is reported to have ordered 20 passenger locomotives from the Baldwin Locomotive Works.

The San Pedro, Los Angeles & Salt Lake is reported to have ordered 51 freight and passenger locomotives from the Baldwin Locomotive Works.

The Maine Central, as reported in our issue of October 14, has ordered four 10-wheel (4-6-0) wide fire-box freight locomotives and two 6-wheel (0-6-0) switching lo-

comotives from the American Locomotive Co.

The Cincinnati, Hamilton & Dayton has ordered nine simple 10-wheel (4-6-0) locomotives from the Baldwin Locomotive Works for November 15, 1904, delivery. The locomotives will weigh 140,000 lbs., with 111,500 lbs. on drivers; cylinders, 19 in. x 26 in.; diameters of drivers, 69 in.; extended wagon-top boiler, with a working steam pressure of 180 lbs.; heating surface, 2,142 sq. ft.; 291 National Tube Co.'s charcoal iron tubes 2 in. in diameter and 13 ft. long; steel fire-box, 108 in. long and 34 in. wide; grate area, 25 sq. ft.; tank capacity, 5,000 gallons of water, and coal capacity, 12 tons. The special equipment includes: Westinghouse air-brakes, Taylor axles and piston rod packings, Cook bell ringers, Keasbey & Mattison boiler lagging, Simplex brake-beams, Buckeye couplers, Monitor injectors, Richardson valve rod packings, Coale safety valves, Leach sanding devices, Detroit sight-feed lubricators, Pittsburg Spring & Steel Co.'s springs and Latrobe driving-wheel tires.

The Atlanta & West Point, as reported in our issue of October 7, is having two simple 10-wheel (4-6-0) locomotives built at the Rogers Locomotive Works for November 1, 1904, delivery. These locomotives will weigh 180,000 lbs., with 142,000 lbs. on drivers; cylinders, 21 in. x 28 in.; diameter of drivers, 62 in.; extended wagon-top boiler, with a working steam pressure of 200 lbs.; heating surface, 2,594 sq. ft.; 335 tubes 2 in. in diameter and 13 ft. 8 in. long; grate area, 34.81 sq. ft.; tank capacity, 7,000 gallons of water, and coal capacity, 12 tons. The special equipment includes: Westinghouse air-brakes, steel axles, Cook's bell ringers, sectional Magnesia boiler lagging, National-Hollow brake-beams, Lappin brake-shoes, Moritz couplers, Pyle-National electric headlights, Monitor No. 10 injectors, Ajax metal journal bearings, Jerome piston rod and valve rod packings, Ashton safety valves and steam gages, J. H. Watters sanding devices, Nathan sight-feed lubricators, Midvale tires and 54-in. wheel centers.

CAR BUILDING.

The Baltimore & Ohio is reported to be figuring on additional freight cars.

The Toledo & Ohio Central has ordered 200 box cars from the American Car & Foundry Co.

The Maine Central has ordered 10 refrigerator cars from the Merchants' Despatch Transportation Co.

The Chicago, Burlington & Quincy is considering the purchase of 1,000 box cars of 80,000 lbs. capacity.

The Hidalgo & Northeastern has ordered 12 flat cars and 10 box cars from the Western Steel Car & Foundry Co.

The Western Pacific, according to press reports, has placed orders for 200 ballast cars and 100 miscellaneous cars.

The Chicago, Burlington & Quincy has ordered 10 passenger coaches from the American Car & Foundry Co.

The Atchison, Topeka & Santa Fe is having 35 freight cars built at the Chicago Works of the American Car & Foundry Co.

The Merchants' Despatch Transportation Company is not in the market for additional equipment, but has increased its orders at its Despatch, N. Y., shops.

The Wheeling & Lake Erie, as reported in our issue of October 14, has ordered 1,000 coal cars from the American Car & Foundry Co. These cars will be built at the Madison Works.

The Cincinnati, Hamilton & Dayton is having 1,500 freight cars built at the Madison Works of the American Car & Foundry Co., and 2,500 built at the St. Louis Works of the same company.

The Swift Refrigerator Transportation Company has ordered 100 refrigerator cars from the American Car & Foundry Co., in addition to the orders reported in our issues of September 23 and October 27. This makes a total of 700 cars ordered by this company since September 23.

The Detroit Southern, as reported in our issue of August 26, has contracted with the American Car & Foundry Co., Detroit, Mich., for the rebuilding of from 800 to 1,000 freight cars, of which 75 per cent. are coal and 25 per cent. box. The company has also contracted with the Illinois Car Co., of Urbana, Ohio, for rebuilding 100 coal and 50 box cars.

The Swift Refrigerator Transportation Company has ordered 200 double-deck stock cars of 60,000 lbs. capacity from the Mt. Vernon Car Manufacturing Co. for immediate delivery. These cars will be 36 ft. long over end sills and 9 ft. wide over side sills. The special equipment includes: Bettendorf bolsters, Chicago Railway Equipment Co.'s brake-beams, Cardwell brake-shoes, Westinghouse air-brakes, Camel brasses, Major steel couplers, Swift standard door fastenings, doors and trucks and Miner tandem draft rigging.

BRIDGE BUILDING.

ALTON, ILL.—The Alton & Granite City Electric Railway, it is reported, has given a contract to the Kenwood Bridge Co., of Chicago, for a 1,500-ft. viaduct.

ANSON, WIS.—This town will build a steel bridge over the Chippewa river to cost about $10,000.

BOSTON, MASS.—The bids opened October 12 at the office of City Engineer Jackson for the steel superstructure of the Boston approach viaduct, and the seven fixed spans of Atlantic avenue bridge, aggregating about 550 ft. in length, were: McClintic-Marshall Construction Co., $84,450; Pennsylvania Steel Co., $89,000; Boston Bridge Works, $107,566; King Bridge Co., $109,880; Phœnix Bridge Co., $110,274; Canton Bridge Co., $115,500; New England Structural Co., $125,000; American Bridge Co., $129,950; Eastern Bridge & Structural Co., $130,000, and H. P. Converse & Co., $136,000.

BRADFORD, ONT.—It is the intention of the Dominion Government to build a steel bridge over the Holland River at this place.

CINCINNATI, OHIO.—Bids are wanted October 29 by the Board of County Commissioners for repairing the west abutment of Miamitown bridge, in Whitewater township. Eugene L. Lewis is Auditor.

CLEVELAND, OHIO.—Separate bids are wanted November 9 by the Board of Commissioners of Cuyahoga County for steel bridges in Newburg, Brecksville, Royalton and Middleburg townships; also for a concrete steel culvert in East Cleveland and some stone and concrete steel masonry work in Collinwood and at Brooklyn. Julius C. Dorn is Clerk.

EAGLE POINT, WIS.—The town has voted to bond itself for its share of the cost of a new bridge, to be built jointly with the town of Anson, at a cost of about $7,500.

EVANSVILLE, IND.—The Evansville & Eastern Electric Ry. has given a contract to the American Bridge Co., of Lafayette, Ind., for two bridges, each 160 ft. long, one over Pigeon Creek and the other over Cypress Creek, to be finished by March 1 of next year.

FREDERICKSBURG, VA.—The Board of Supervisors of Spottsylvania and Culpeper counties, at a recent meeting, decided to build a steel bridge over the Rapidan River at this place.

FREDERICTON, N. B.—Surveys are being made by the Provincial Public Works Department for a new steel bridge to be built over the St. John River at Pokiok.

GLADSTONE, MAN.—The municipal councils of Westbourne and Lansdowne will build a Warren steel truss bridge on concrete abutments over the White Mud river.

GLENOLDEN, PA.—The City Council has passed an ordinance for the new P. B. & W. bridge.

GLOUCESTER, MASS.—Plans for the new Western avenue bridge over the Annisquam River, reports say, are being made. W. L. Webber is City Engineer.

HARRISBURG, PA.—The Dauphin County Court confirmed the report of the viewers which recommended the rebuilding of a bridge over the Susquehanna River near Catawissa. The following are the lowest bidders for State bridges, as given out by the Board of Public Buildings and Grounds: Conewago bridge, York County, York Bridge Company, $49,000; Conoquenessing, Butler County, King Bridge Company, $33,800; Muncy bridge, Lycoming County, W. H. Gulick & Co., $16,210; Catawissa bridge, Columbia County, Penn Bridge Company, $21,940.

HARVEY, ILL.—The Blue Island, Riverdale & Hammond Electric road, it is reported, will build a new bridge over the Calumet, to be completed by June next.

KANSAS CITY, MO.—The City Council, reports say, has appropriated $15,000 to build a steel viaduct over the Belt Line tracks at Kansas avenue.

LAWTON, OKLA. T.—Press reports state that the recent high water has carried away every bridge of the railroads entering this place with the exception of the Enid line of the Rock Island. About a dozen bridges, in all, have been destroyed.

MANISTEE, MICH.—A vote will be taken on the question of building a new bridge over the Manistee River at Maple street, to cost about $30,000.

MEXICO CITY, MEX.—Press reports state that the War Department has approved the plans for the large iron bridge to be built over the Grand Canal to San Lazaro and Vaquita plains, on which work will soon be commenced.

MONTGOMERY, ALA.—A steel toll bridge over the Alabama river will soon be built by the Montgomery Bridge & Improvement Co., of which the Converse Bridge Co., of Chattanooga, owns the controlling interest.

MT. CLEMENS, MICH.—A new bridge, to be built jointly by Clinton and Erie townships over the Clinton River at South Gratiot, is proposed, to cost about $25,000.

MUIR, MICH.—At the election to be held November 8 the question of building a new bridge over Maple River will be voted on.

NEW YORK, N. Y.—Bids for the anchorages of the Manhattan bridge, which will cost about $1,250,000, may be asked by Bridge Commissioner G. L. Best some time this month.

RAT PORTAGE, ONT.—A foot bridge will be built over the Canadian Pacific tracks at Julius Creek; also the approaches to a steel bridge over the east branch of the Winnipeg River.

RICHMOND, IND.—Bids are wanted November 7 by Wayne County Commissioners for a bridge on the county line between Henry and Wayne counties; also for a bridge in Harrison township. George W. Callaway is Chairman.

THEBES, ILL.—The new bridge over the Mississippi river between Gray's Point, Mo., and this place, it is reported, will be completed by the first of next year.

TOLEDO, OHIO.—Separate bids are wanted October 24 by the Board of County Commissioners of Lucas County for the following bridge work: For building the substructure of a bridge on Central avenue over Ten-Mile Creek, in Sylvania township; for the substructure of a bridge over Ten-Mile Creek, in section 19, Sylvania township; for the substructure of a bridge over Ten-Mile Creek, in Washington township; for the superstructure of a bridge over Otter Creek, in Oregon township; for a bridge over Swan Creek, in Waterville township; for one abutment of a bridge in the same township, and

for building 1,900 ft. of protection wall on Stickney avenue, in Washington township. David T. Davies, Jr., is Auditor.

WASHINGTON, D. C.—Engineer of Bridges W. J. Douglas, in his annual report, asks for an appropriation of $38,000 to build the K street bridge over Rock Creek; also that a temporary bridge be built over Piney Branch or a permanent one to cost about $100,000.

WATERBURY, CONN.—A bridge is proposed on the westerly side of the Naugatuck river over the New York, New Haven & Hartford tracks.

WILLIMANTIC, CONN.—A foot bridge is proposed over the Willimantic River to cost about $10,000.

ZANESVILLE, OHIO.—Bids are wanted Oct. 27 by L. E. Brelsford, Muskingum County Auditor, for the superstructure of a highway bridge in Newton township to consist of one 120-ft. span with two approaches, each 25 ft. long, with a 16-ft. roadway.

Other Structures.

ELIZABETH, N. J.—The Central Railroad of New Jersey has commenced rebuilding its docks at Elizabethport between Livingston street and Port avenue, a distance of 1,800 ft. The work is being done by the New Jersey Dock & Bridge Building Co., who received the contract October 7 at about $200,000 from among 22 bidders. The dredging work, which will cost about $50,000, has already been started. It will take about a year to complete the entire work.

EL PASO, TEX.—The El Paso Union Depot Co. has given a contract for building the union passenger station here to Frank Powers. At the time bids were opened, M. M. Rocke, of Houston, was the lowest bidder, but has since withdrawn his bid.

FINDLAY, OHIO.—The Toledo, Bowling Green & Southern has commenced work on a new power house 120 ft. x 150 ft., which is to furnish the power for the entire line.

GRAND RAPIDS, MICH.—The Grand Trunk, it is reported, has bought land with a frontage of 100 ft. on Bridge street as a site for a new passenger station to cost about $50,000.

LOS ANGELES, CAL.—The Salt Lake & Los Angeles has secured a site at First street and the river on which a new passenger station to cost about $100,000 will soon be built.

MCKINNEY, TEX.—The State Railroad Commission has issued an order directing the Missouri, Kansas & Texas and the Houston & Texas Central to jointly build a new passenger station by March 1 next.

MARBLE CITY, IND. T.—The Kansas City Southern, it is reported, will build a new passenger station of marble construction at this place.

MINOT, N. DAK.—The Great Northern, it is reported, will at once build a brick passenger station 50 ft. x 150 ft. to replace the structure recently destroyed by fire.

MONTREAL, QUE.—The Simplex Railway Appliance Co., according to reports from Montreal, has announced that the company is ready to build extensive works in Lachine along the canal bank. The company, some time ago, bought 43 acres with a frontage of about 3,000 ft. on the canal as a site for large car works. About 15 buildings will be put up to have a capacity of about 25 cars a day and to also make other railroad appliances.

PUEBLO, COLO.—The Denver & Rio Grande, reports say, will begin work at once on a new roundhouse and repair shops to be built on the site of the present ones to double their capacity, which is now 500 cars.

SPRINGFIELD, OHIO.—The Commercial Club has subscribed $1,000 towards buying a site for the Detroit Southern car shops.

TAMPA, FLA.—The Seaboard Air Line has an option for Grassy Island near the mouth of the Hillsboro river, where it proposes to build terminals costing about $300,000.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ALPENA, GAYLORD & WESTERN.—Maps have been filed by this company showing the location of its proposed route from Alpena, on Lake Huron, through Otsego, Antrim, Kalkaska and Grand Travers counties to Gaylord, 65 miles. C. M. Stevens, 602 Majestic building, Detroit, is said to be interested. (See Construction Supplement.)

AMADOR RAILROAD.—A charter has been granted this company in Delaware with an authorized capital of $1,000,000. The company is authorized by its charter to build and operate railroads, but the proposed route is not stated. E. B. Maples, Wilmington, Del., is said to be interested.

BAYFIELD, LAKE SHORE & WESTERN.—A contract has been let to H. M. Juel, of Cornucopia, Wis., for grading this proposed railroad from Bayfield, Wis., to Cornucopia, 15 miles. A contract for clearing the right of way has been let to Fred Closen, of the same city. It is proposed to finish the 15 miles this year and to begin work on the remaining 65 miles to Superior in the spring. J. Stevenson, Bayfield, Wis., is President. (October 7, p. 119.)

BAY MINETTE & FORT MORGAN.—An officer writes that a contract has been let to W. J. Oliver, Knoxville, Tenn., for building this proposed road from Bay Minette, Ala., in a southerly direction for a distance of 37 miles. The work is light, with a maximum grade of 1 per cent. and a maximum curvature of 4 degrees. There will be no steel bridges. Grading is now in progress. W. W. Olney, Bay Minette, Ala., is Chief Engineer, and T. P. Hamm, 509 Stewart Building, Chicago, Ill., is President. (October 14, p. 125.)

CUMBERLAND R. R. (SOUTHERN).—An officer writes confirming the report that a contract has been let to S. P. Condon & Co., Knoxville, Tenn., for building this road from Laurel Fork, Tenn., to a point on the Clear Fork river, in Bell County, Ky., about 14 miles. The work, which is now under way, is light, and does not include any important bridges. Henry Fonde, Knoxville, Tenn., is President. (October 7, p. 119.)

DALLAS, CLEBURNE & SOUTHWESTERN.—Press reports state that this company is about to build an extension from Cleburne, Tex., southwest to Dallas. The road runs at present between Egan and Cleburne, 10 miles. B. F. McDonald, Fort Scott, Kan., is President, and W. D. Meyers, of Cleburne, Tex., General Manager. (See Construction Supplement.)

DETROIT-BAY CITY TRACTION.—Incorporation has been granted this company in Michigan with an authorized capital of $1,000,000. It is proposed to build an electric railroad from Detroit through Pontiac, Mayville and other points to Bay City, 108 miles. L. E. Farnum, J. H. Christian, C. V. Dard and others, of Detroit, Mich., are interested.

GARLAND WESTERN.—The State Board of Incorporators of Arkansas has granted this company an extension of three years in which to build the first 5 miles of the line. The road is projected to run from Hot Springs, Ark., in a westerly direction to Mena, 80 miles. S. W. Fordyce, Hot Springs, Ark., is President. (See Construction Supplement.)

INTERCOLONIAL.—Bids will be received until October 27 for grading for a second track between Stellarton and New Glasgow, N. S. Plans and specifications may be seen at the station master's office at New Glasgow, N. S., and at the Chief Engineer's office at Moncton, N. B.

LAKE SUPERIOR & SOUTHEASTERN.—Articles of incorporation have been filed by this company in Wisconsin. It is proposed to build a railroad from Superior southeast through Douglas, Washburn, Bayfield, Sawyer and other counties to Marshfield, a total distance of 100 miles. R. T. Merrill, C. E. Carter, H. D. Van Dyke and others, of Milwaukee, Wis., are incorporators.

LYONS BELT R. R.—Incorporation has been granted this company in Illinois to build a railroad from Lyons southwest to Proviso, in Cook County, five miles. The headquarters will be at Chicago. W. S. Joslyn, F. F. Heck, F. C. Schultz and others, of Chicago, are incorporators.

MEXICAN CENTRAL.—The Mexican Government has granted this company an extension of time to Oct. 1, 1905, for building the section from Zapotlan, in the state of Jalisco, to Colima, where connection will be made with the road which runs to Manzanillo.

MEXICAN ROADS.—The American-Mexican Lumber Co., which has recently acquired extensive timber lands in the western part of the State of Chihuahua, is about to build a railroad from these timber lands to Casas Grandes, 75 miles. Connection will be made with the Rio Grande, Sierra Madre & Pacific at Casas Grandes. Benjamin B. Cheney, of Boston, Mass., is said to be back of the project.

Application has been made to the Mexican Government by a syndicate for a concession to build and operate a railroad from Morelia east to Magdalena, in the State of Mexico, 80 miles.

The North American & Mexican Development Co., which was recently organized with a capital of $250,000, is reported about to build a railroad from Oaxaca to a point on the isthmus of Tehuantepec 250 miles. W. W. Nelson, Kansas City, Mo., is said to be interested in the project.

It is announced that the contract will soon be let for building the La Dicha & Pacific railroad, which is to run from La Dicha, in the State of Guerrero, to the port of Marquez, on the Pacific coast, a distance of 75 miles. The company is capitalized at $2,000,000 and its principal office is at La Dicha. George Mitchell, of the La Dicha Mining Co., is one of the directors. Surveys for this line have been completed. The maximum grade is 1½ per cent. It is the intention of the company to eventually extend the line to Chilpancingo, with a view to connecting with the projected extension of the Interoceanic to that point, which is now being surveyed.

SOUTHERN.—This company is now using its double-track line between Washington, D. C., and Orange, Va., 85 miles. This second-track work was described in the *Railroad Gazette* of July 15 last.

SPRINGFIELD, CHARLESTON, WASHINGTON & CHILLICOTHE (ELECTRIC).—An officer writes that the contract has been let to the Champion Construction Co. for building this electric railroad from Springfield, Ohio, southeast through Charleston and Washington Courthouse to Chillicothe, 70 miles. Work is already in progress and it is expected to have the line completed in the fall of 1905. H. L. Rockfield, Springfield, Ohio, is President, and E. B. Gunn, Chief Engineer. (September 30, p. 111.)

UINTAH R. R.—Press reports state that this road has been finished from Dragon, Colo., to Mack, 50 miles. Connection will be made with the Denver & Rio Grande at the latter point. Surveys are now in progress for a proposed extension from Dragon to Vernal, Utah. The new line will be opened for traffic at once and it is stated that work will be begun on the extension as soon as the surveys are completed.

VERA CRUZ & PACIFIC.—A contract has been let by this company to Woodhouse & Hardie for building the culverts and retaining walls along its main line. A good deal of masonry work which has been condemned will be removed and replaced by first class material. It is stated that Hampson & Smith, of the City of Mexico, will furnish the stone ballast for the line and will immediately establish a rock crushing plant at Penuelos, a short distance from Cordova. Thomas Milan is President of the railroad.

WISCONSIN & ILLINOIS.—Articles of incorporation have been filed by this company in Wisconsin. It is proposed to build from Warren, Ill., in a northwesterly direction

through Bloomington to Cuba City, Ipswich, Platteville and Lancaster. Branch lines will be run from Ipswich to East Dubuque and from Cuba City to Hazel Green. The names of the incorporators are not given.

RAILROAD CORPORATION NEWS.

Bath & Hammondsport.—The Central Trust Co., of New York, has applied for a receiver for this railroad, which runs from Bath, N. Y., to Hammondsport, 10 miles. The company has defaulted the interest on a mortgage of $200,000 held by the Trust Co.

Boston & Maine.—At the annual meeting of the stockholders on October 12, it was voted to issue $525,000 4 per cent. 20-year gold bonds for refunding purposes.

Canada Atlantic.—At the meeting of the stockholders of the Grand Trunk in London on September 29, President Wilson, referring to the proposed acquisition by that company of the Canada Atlantic, in consideration of the guarantee of the principal and interest of $16,000,000 new 4 per cent. 50-year gold bonds of the Canada Atlantic, said in part: "It is with respect to its facilities for grain traffic that the road will be such an extremely useful adjunct to our line. During the last season there was handled in the elevators at Depot Harbor no less than 4,190,963 bushels. Its acquisition will enable us to have a terminus at Ottawa. The company at present has a bonded debt of $14,000,000, and the earnings during the past three years have been more than sufficient to pay the 4 per cent. interest. We propose to guarantee that interest, and, as it is always useful to have money in reserve, we shall extend the mortgage by a further two millions in order to have money to improve the road. We shall receive very substantial assets, among which is a valuable fleet of ships which carry the grain between the United States and Canada." (October 7, p. 119.)

Canadian Pacific.—In accordance with the resolution passed at the annual meeting of the stockholders on October 5, $16,900,000 of new stock will be issued at once, and stockholders of record October 27 may subscribe at par on a basis of 20 per cent. of their present holdings. This issue is part of the $25,500,000 issue which was authorized at the stockholders' meeting. Stock upon which payments have been made in full will be entitled to dividends for the first half of the year ending June 30, 1905. (October 7, p. 119.)

Central Pacific.—This company has sold to Kuhn, Loeb & Co. and Speyer & Co. $8,300,000 4 per cent. bonds guaranteed by the Southern Pacific, and secured by a first mortgage on the Lucin cut-off. This is part of an authorized issue of $10,000,000. Announcement is made by the bankers that all of the bonds were disposed of at once.

Delaware, Lackawanna & Western.—The management of the Lackawanna has purchased from John H. Starin & Co. the property and privileges belonging to the freight lighterage department in New York harbor. Heretofore these privileges have been owned by the Starin Company and operated under contract with the Lackawanna. (October 14, p. 126.)

Des Moines & Fort Dodge.—An announcement has been made that this company has sold to Redmond & Co., bankers, New York, $3,072,000 4 per cent. first-mortgage bonds which have been issued to retire a like amount of bonds maturing on January 1, 1905. The bonds to be retired consist of $1,200,000 first-mortgage 4s, $1,200,000 first-mortgage 2½s and $672,000 extension 4s. The new bonds are dated January 1, 1905, and are a first mortgage on the entire property. They are guaranteed principal and interest by the Minneapolis & St. Louis. It is stated that the holders of the old bonds will be offered the privilege of exchanging them for the new ones upon terms to be announced later.

Grand Trunk.—See Canada Atlantic.

Lehigh Valley.—This company has sold to Drexel & Co. and E. B. Smith & Co., of Philadelphia, $15,000,000 general consolidated mortgage 4 per cent. bonds. The proceeds of the sale will be used in part to retire $7,900,000 mortgage and collateral trust bonds of 1897 subject to call at 107½, $2,000,000 coal trust certificates of 1902, subject to call at 102½ and interest. The remainder of the new issue, amounting to $3,000,000, will be kept in the treasury of the company for general purposes.

Norfolk & Western.—This company has sold to Brown Bros. & Co., of New York, $5,000,000 4 per cent. 40-year divisional first lien and general mortgage bonds. The proceeds will be used for second track, replacement of bridges, additional yard facilities and new equipment. These bonds are part of a total mortgage for $35,000,000 authorized last year. The annual report recently published stated that the sum of $10,000,000 was to be put into the company's treasury at once. This $5,000,000 issue is evidently part of the ten million.

New York, Susquehanna & Western.—The report of this company for the fiscal year ending June 30, 1904, shows gross earnings of $2,659,790, a decrease of $23,237. Operating expenses were $1,549,978, an increase of $80,733, leaving a decrease in net earnings of $103,970. The percentage of operating expenses to gross earnings increased from 54.76 in 1903 to 58.27 in 1904. This increase was due in part to large expenditures for maintenance owing to the damage done to roadbed and bridges by the flood of October, 1903. After subtracting all fixed charges and expenditures for improvements, the surplus carried to the credit of profit and loss was $216,785, a decrease of $88,879.

Pere Marquette.—Paine & Wilson and Baker, Watts & Co., of Baltimore, are offering $150,000 of a new issue of $1,200,000 4½ per cent. equipment trust bonds dated October 1, 1904. These bonds are secured by new equipment costing $1,500,000.

Underground Electric Railway Company of London.—Application has been made by this company to the New York Stock Exchange to list $16,550,000 of its 5 per cent. notes of 1908. These notes are the profit-sharing notes issued by Speyer & Co. in the early part of 1904 in connection with the Yerkes syndicate in London.

Vera Cruz & Pacific.—In connection with the $6,000,000 first-mortgage gold bonds recently sold to Speyer & Co., of New York, it is announced that the proceeds from the sale will be used for refunding purposes. The total authorized issue is limited to $7,000,000 and the principal is due July 1, 1934. In consideration of the transfer to the government of Mexico of the total capital stock of the railroad company the Mexican Government has guaranteed the payment of the principal and interest on the bonds. (October 7, p. 120.)

Wisconsin Central.—The report of this company for the fiscal year ending June 30 shows gross receipts of $6,466,176, a decrease of $185,686 or 2.8 per cent. Operating expenses were $4,342,439, an increase of $136,446, leaving a decrease in net earnings of $322,132. The losses in operating were due mainly to a decrease in the iron ore traffic, which loss alone amounted to $168,893, as compared with 1903. Outside of the iron ore traffic the aggregate tonnage moved by the company was larger than the previous year, the report showing 704,510,412 ton miles, as against 673,736,381 ton miles in 1903. The ratio of expenses to earnings rose from 63.52 per cent. to 67.16 per cent. Part of the explanation of the higher operating cost is found in the unusually severe winter and in advanced wages and higher cost of fuel.

RAILROAD GAZETTE

ESTABLISHED IN APRIL, 1856.
PUBLISHED EVERY FRIDAY BY
THE RAILROAD GAZETTE
At 83 Fulton St., New York.

EDITORIAL ANNOUNCEMENTS:

THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It consists of most of the reading pages and all of the advertisement pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name, Transport and Railroad Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

FRIDAY, OCTOBER 21, 1904.

CONTENTS